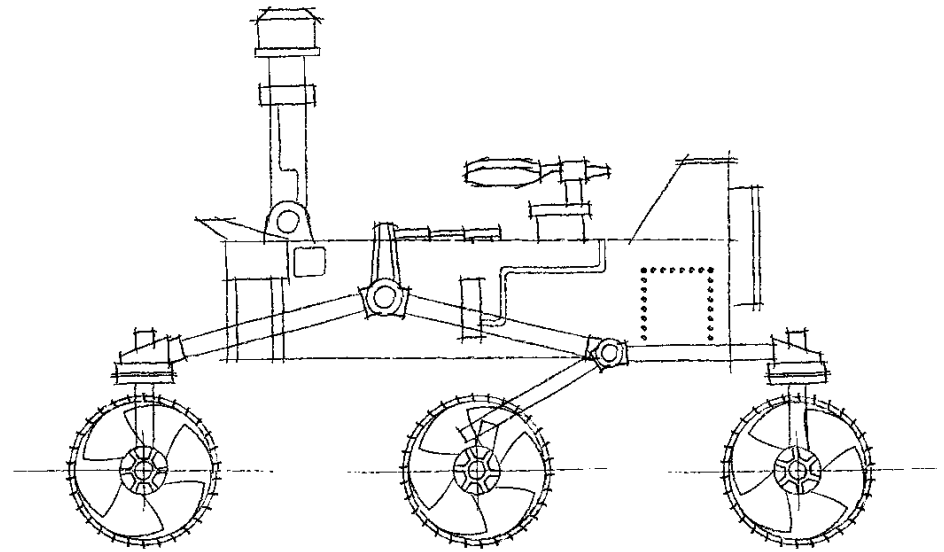


A Rover Driver's View of Site Traversability

Tour of comparative traversability across all the candidate sites

Matt Heverly
M2020 Landing Site Workshop #2
8/4/2015

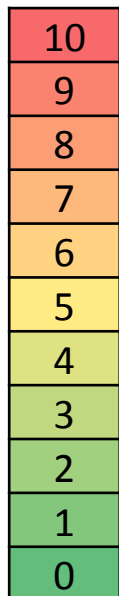


Mars 2020 Project

Objective



- Give a qualitative assessment of the traversability at each of the candidate landing sites.
- Allows for a rough comparison of the site as a whole
 - Does not factor in ROIs
- Assign each site a traversability challenge from 0 – 10



Very difficult to traverse

Easily traversable



- This analysis is based on MSL experience but has not been peer reviewed
- This qualitative assessment should be used in conjunction with more quantitative traverse assessment data
- As we move forward we should more people to weigh in on the qualitative aspects of traversability

Sites Considered

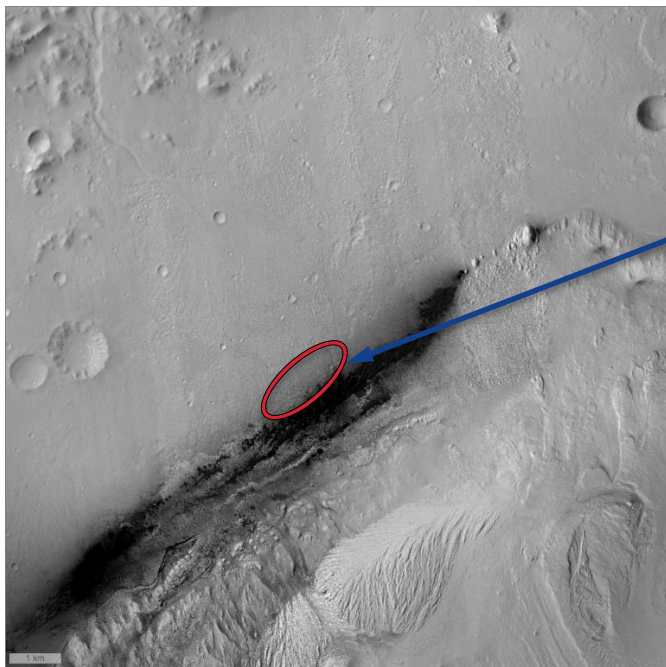


Jet Propulsion Laboratory
California Institute of Technology

Mars 2020 Project

- Gale Crater (used as a basis of comparison)
- Northeast Syrtis Major
- Nili Fossae Trough
- Jezero
- Holden
- McLaughlin Crater
- Southwest Melas Basin
- Mawrth
- East Margaritifer Terra

- Traversability rating of 5 / 10 as a basis of comparison for the rest of the sites
 - Sites with traversability of 0 – 4 are easier than Gale
 - Sites with traversability of 6 – 10 are more difficult than Gale
- Assessment made purely from orbital images with the same resolution used for the other sites

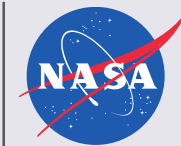


Only looking at the area
where Curiosity has traversed

Score

5

Gale Crater

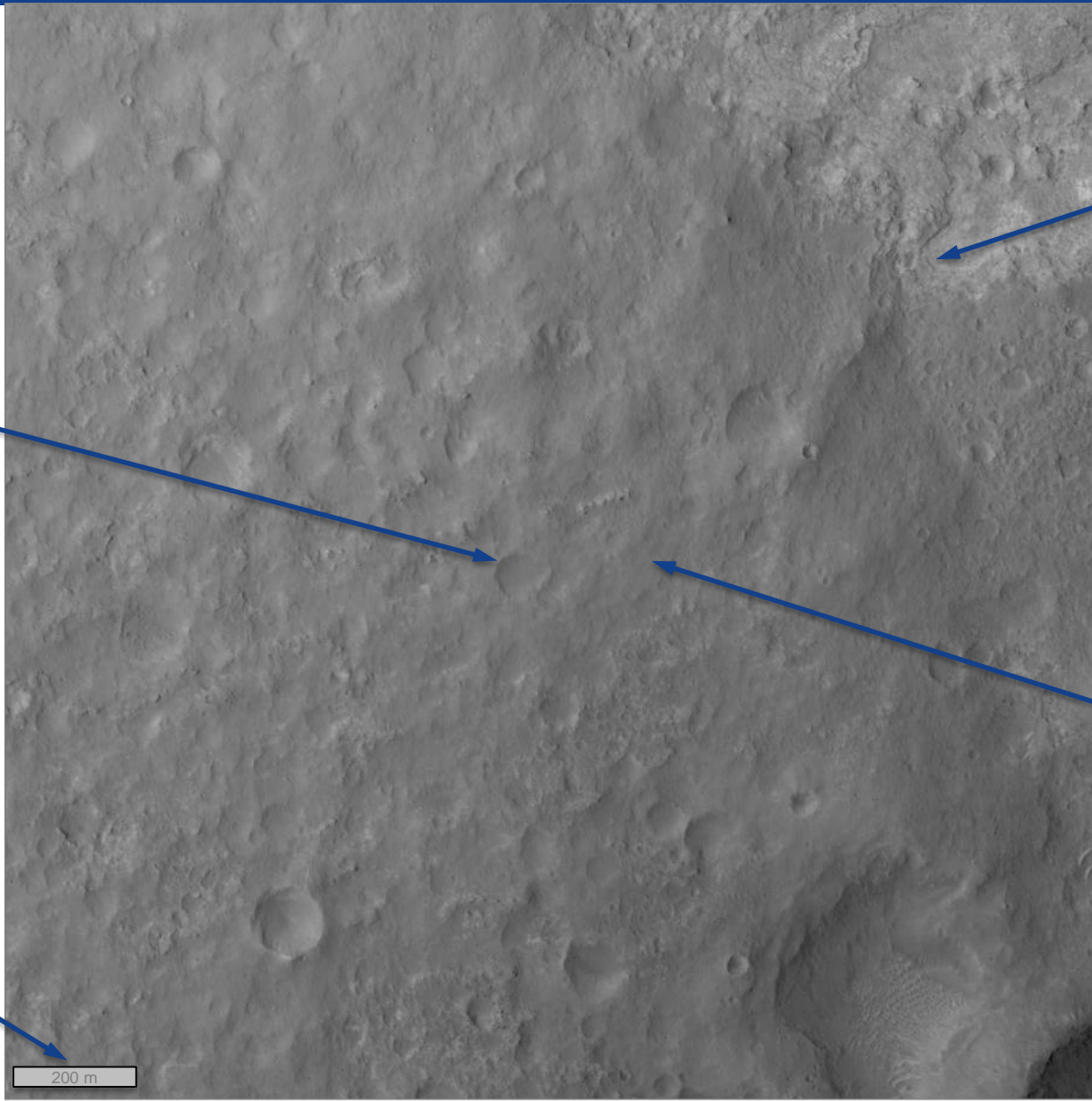


Craters without
significant sand
accumulation

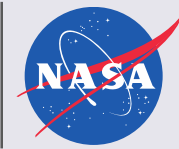
Yellowknife Bay

Smooth plains

Scale bar

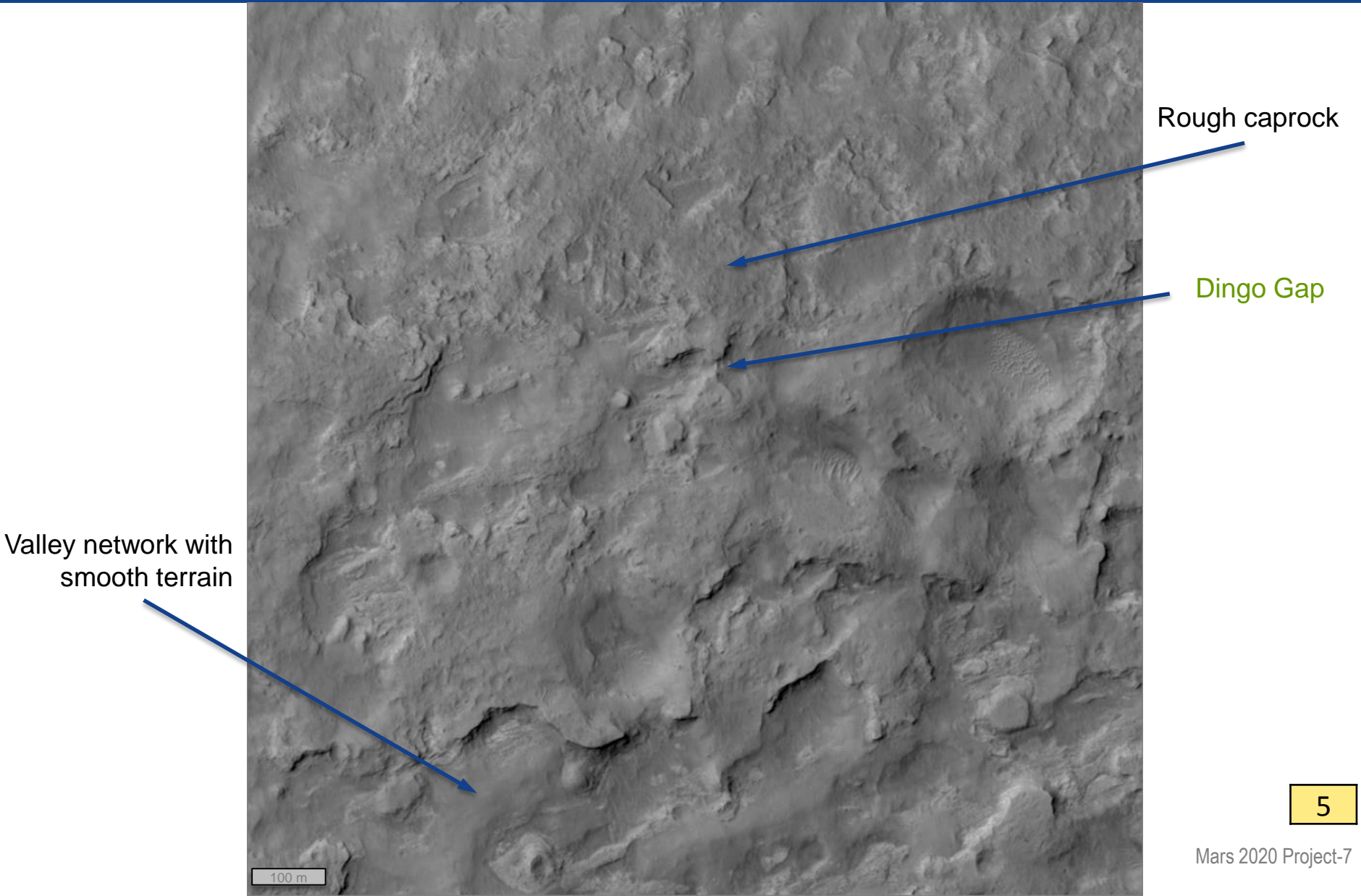


Gale Crater



Jet Propulsion Laboratory
California Institute of Technology

Mars 2020 Project



Gale Crater



Jet Propulsion Laboratory
California Institute of Technology

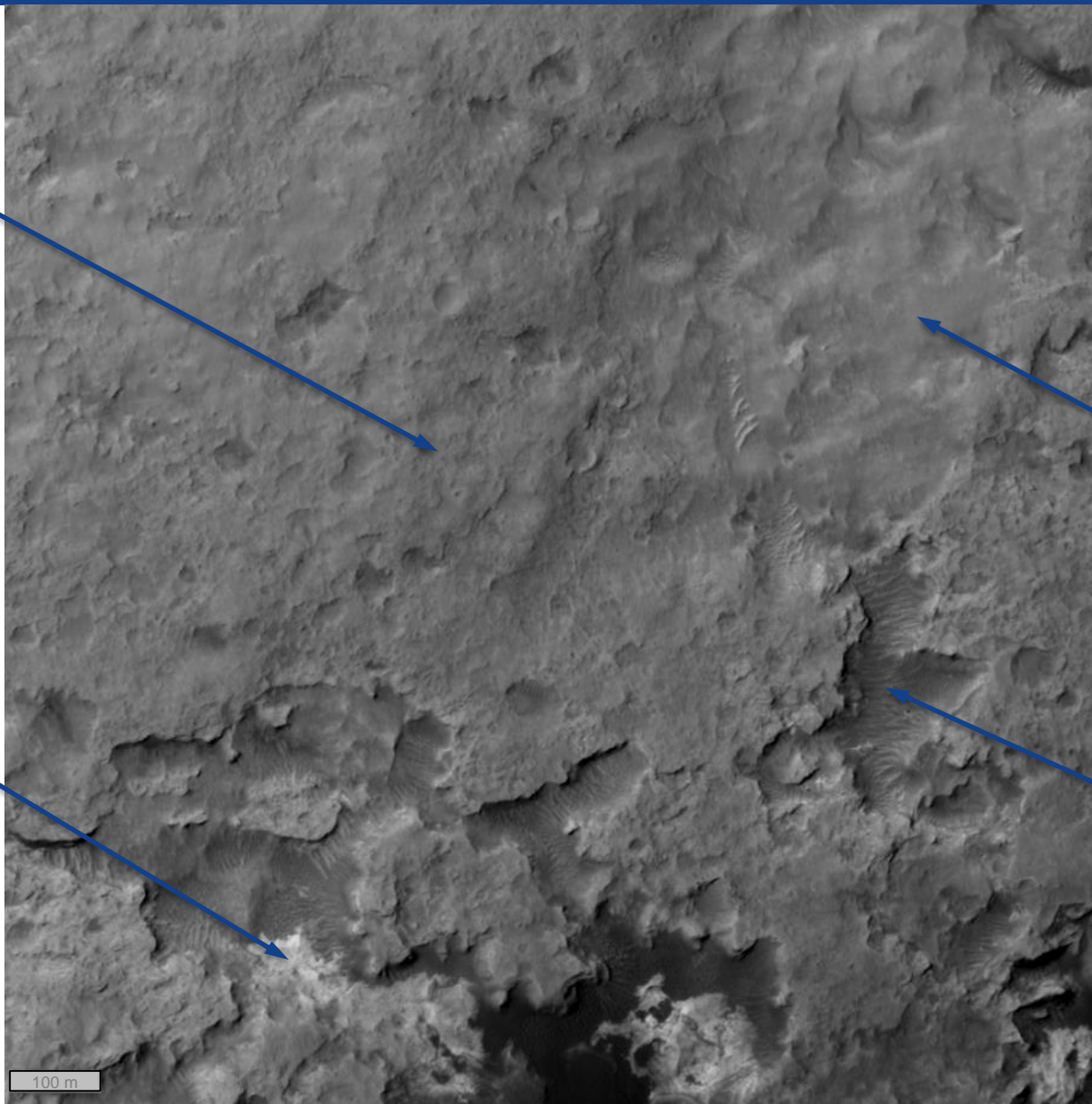
Mars 2020 Project

Rough caprock

Pahrump Hills

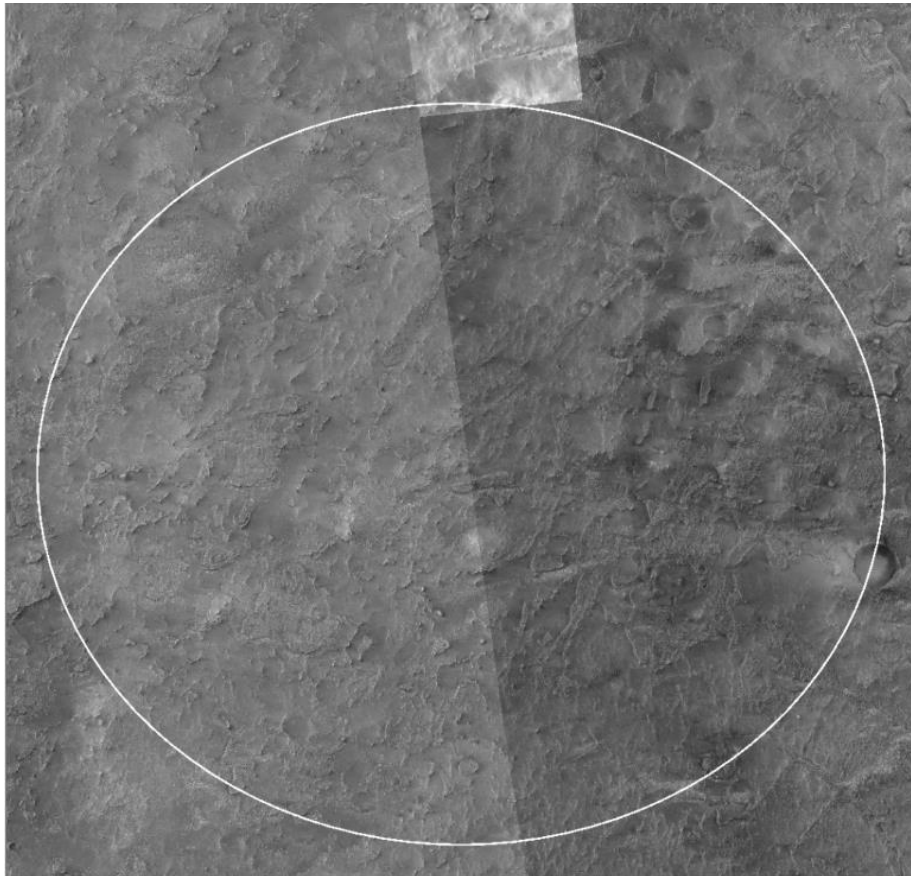
Smooth plains

Valleys with
untraversable
sand

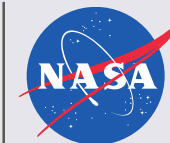


100 m

- Traversability rating of 3 / 10 (more traversable than Gale)
 - Lots of obstacles, but there are ways around them
 - Low lying smooth valleys for fast driving, but long traverse distances to get around non-traversable features



Northeast Syrtis Major

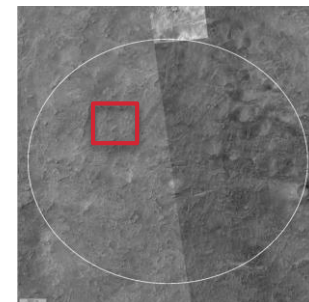
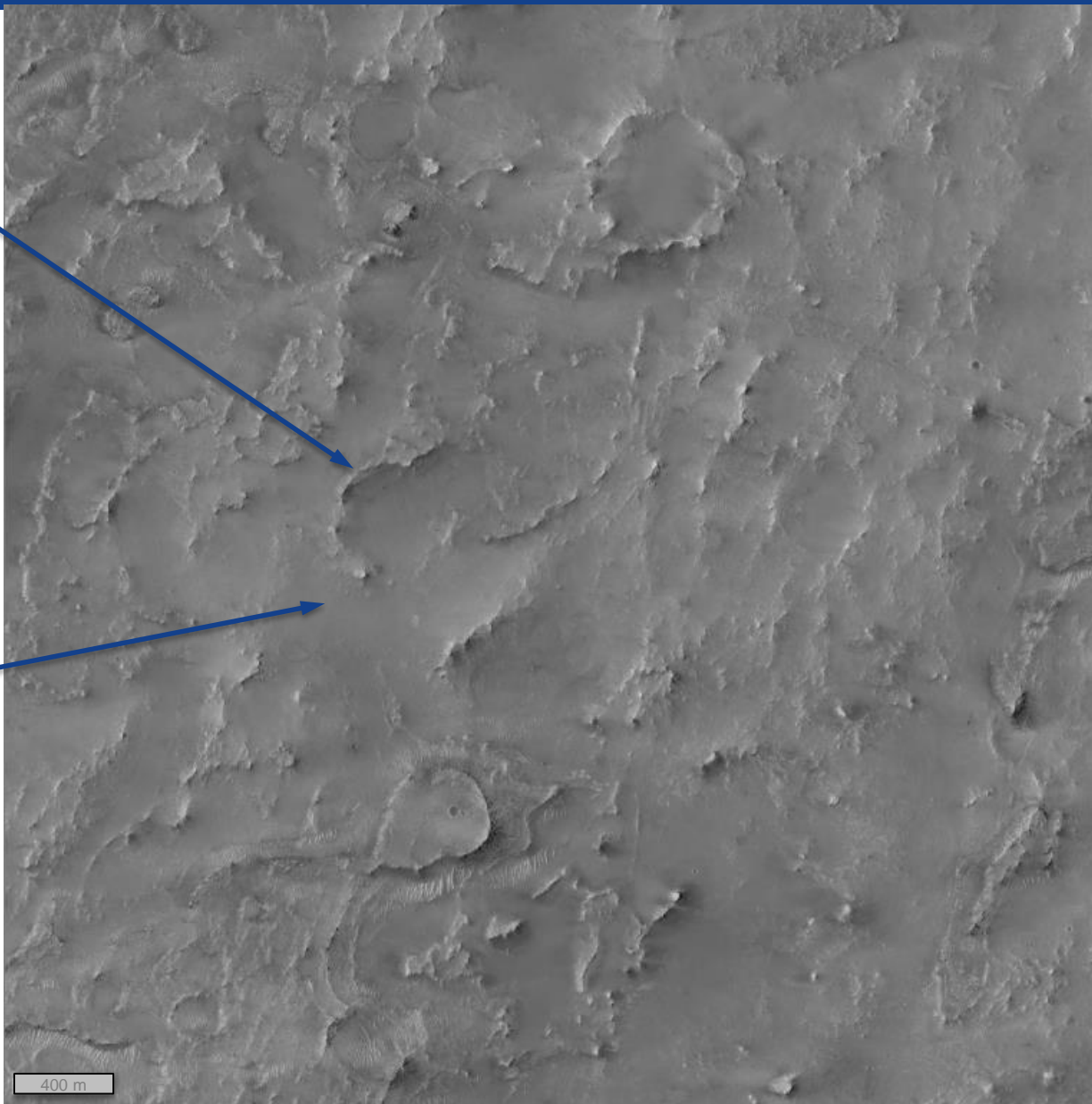


Jet Propulsion Laboratory
California Institute of Technology

Mars 2020 Project

Scarps and
linear features
that are difficult
to traverse

Network of
smooth valleys
around non-
traversable
features



Red square shows
approximate location
and size of image
shown to the left

Northeast Syrtis Major

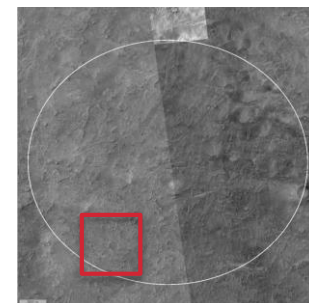
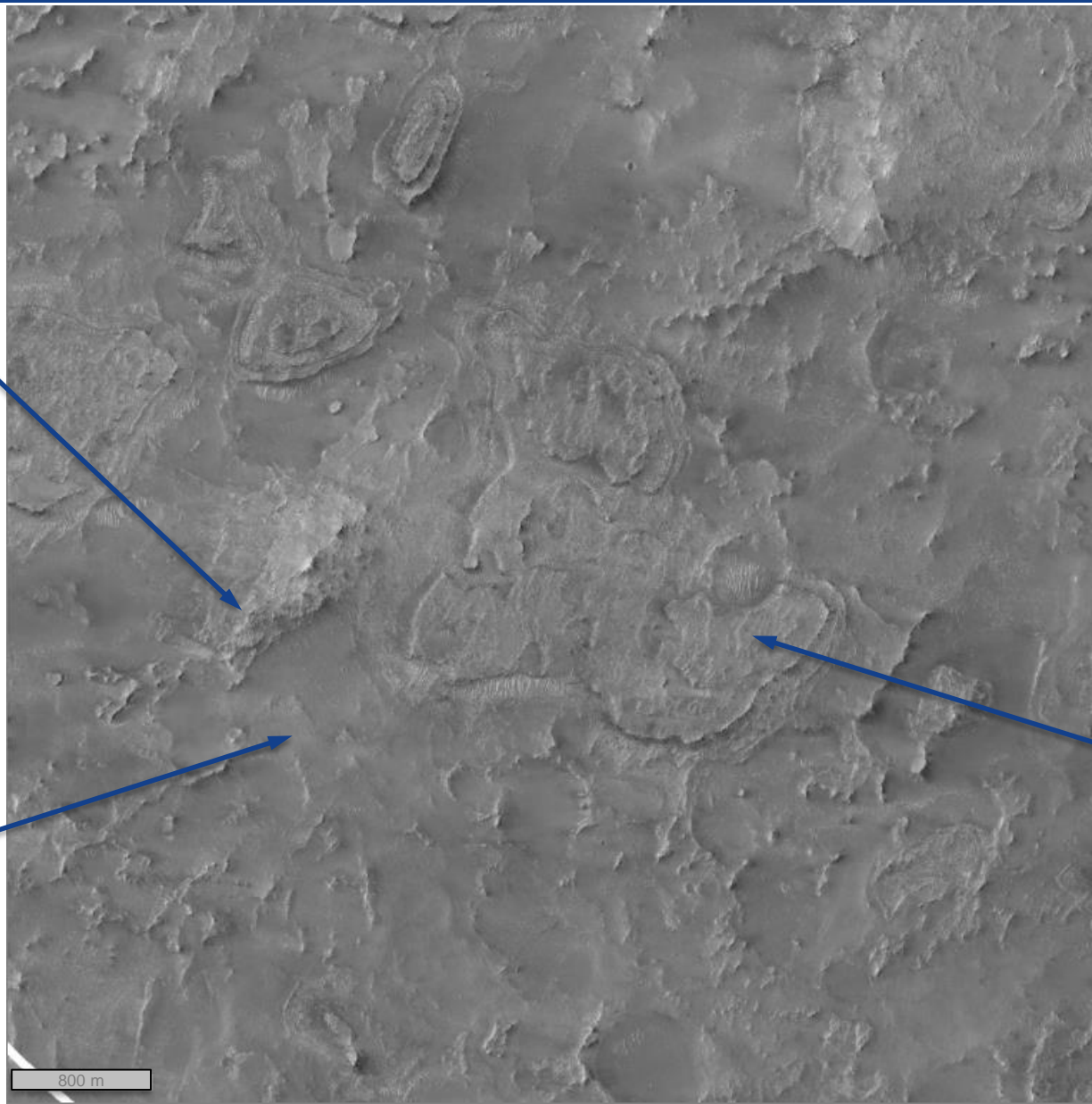


Jet Propulsion Laboratory
California Institute of Technology

Mars 2020 Project

Rock Fields

Smooth valleys
to make it
around non-
traversable
features



Plateaus with
difficult cap
rock

3

Mars 2020 Project-11

Northeast Syrtis Major



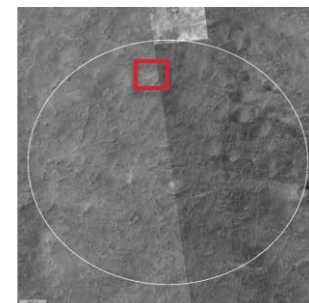
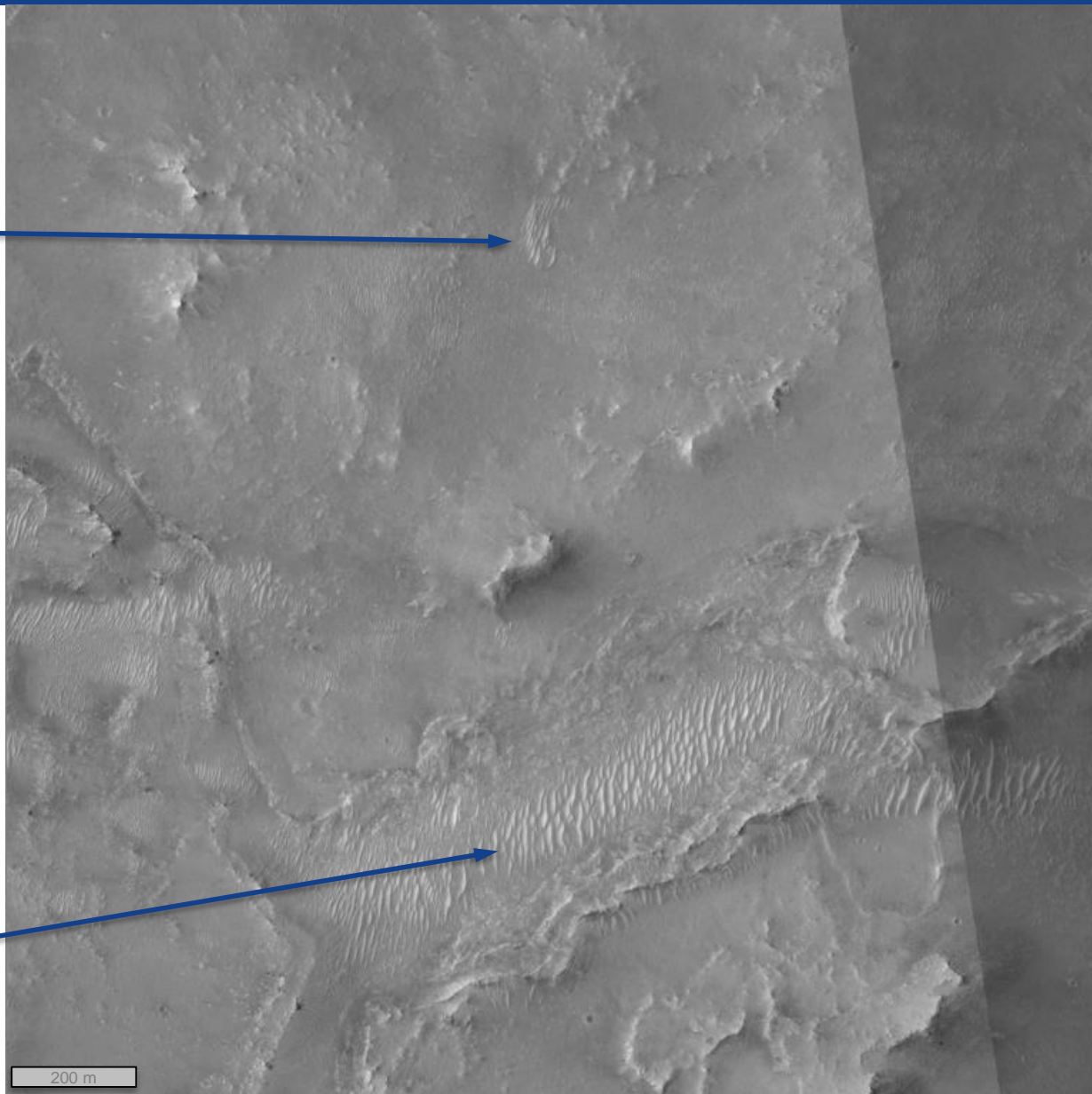
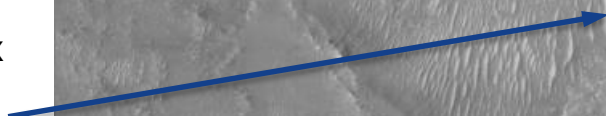
Jet Propulsion Laboratory
California Institute of Technology

Mars 2020 Project

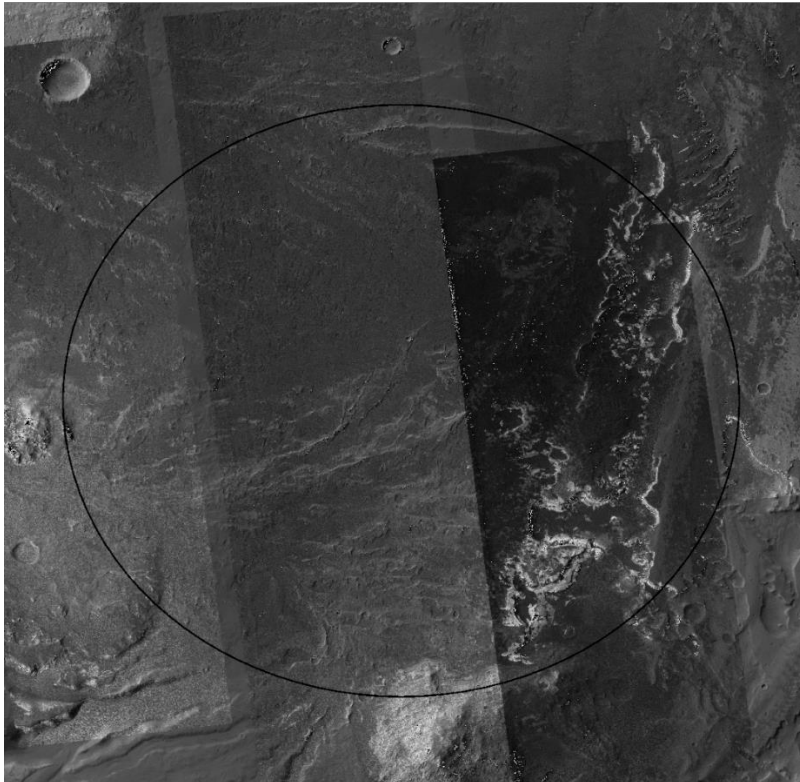
Most sand accumulations are shallow and sparse



Some complex sand ripple fields

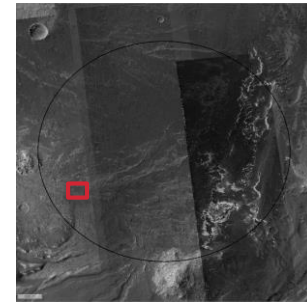
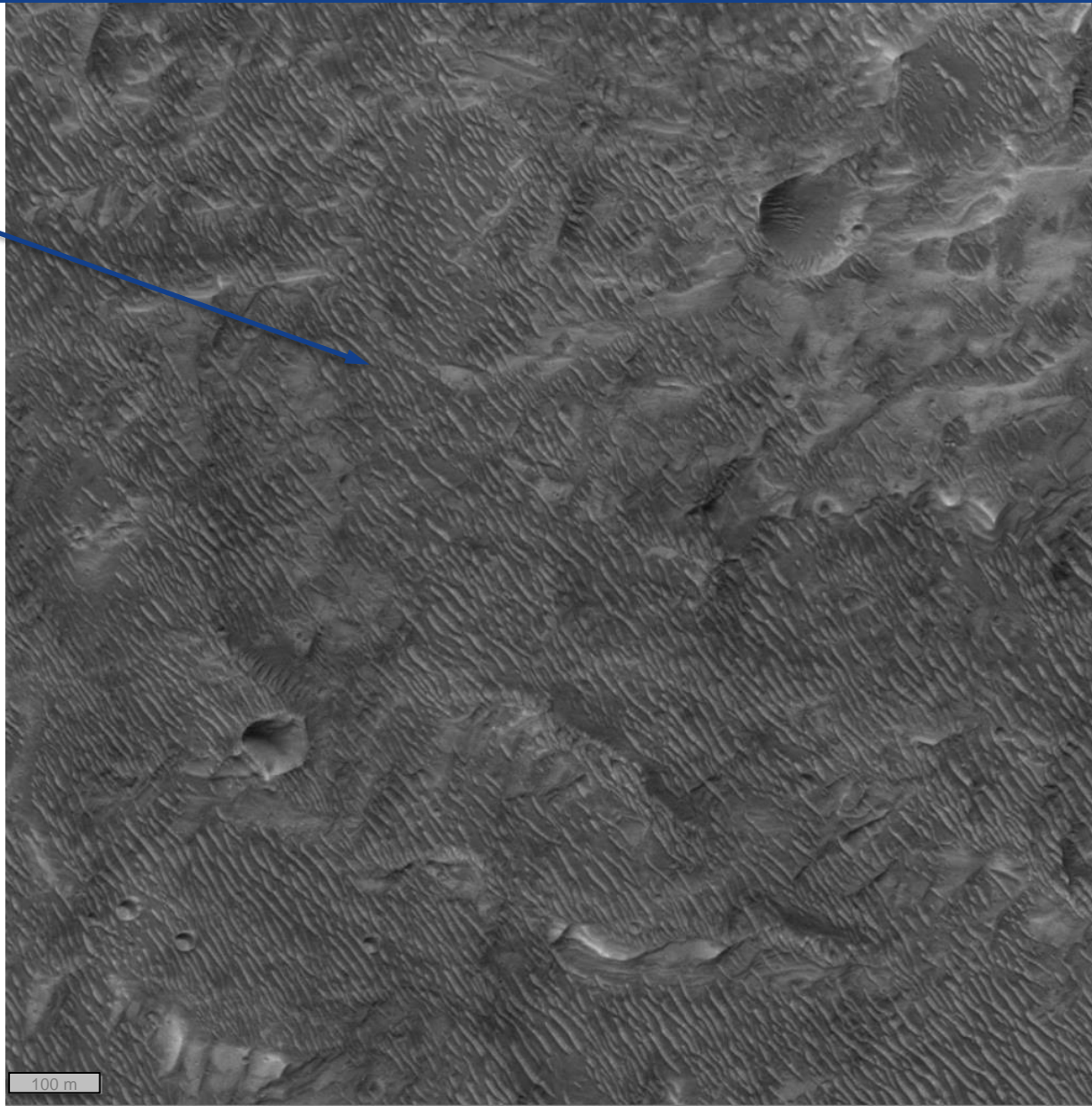


- Traversability rating of 7 / 10 (less traversable than Gale)
 - Higher elevations have undulating terrain with moderate sand coverage
 - Valley have deep sand accumulations that are potentially non-traversable

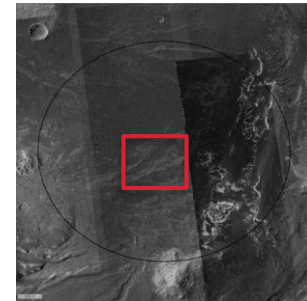
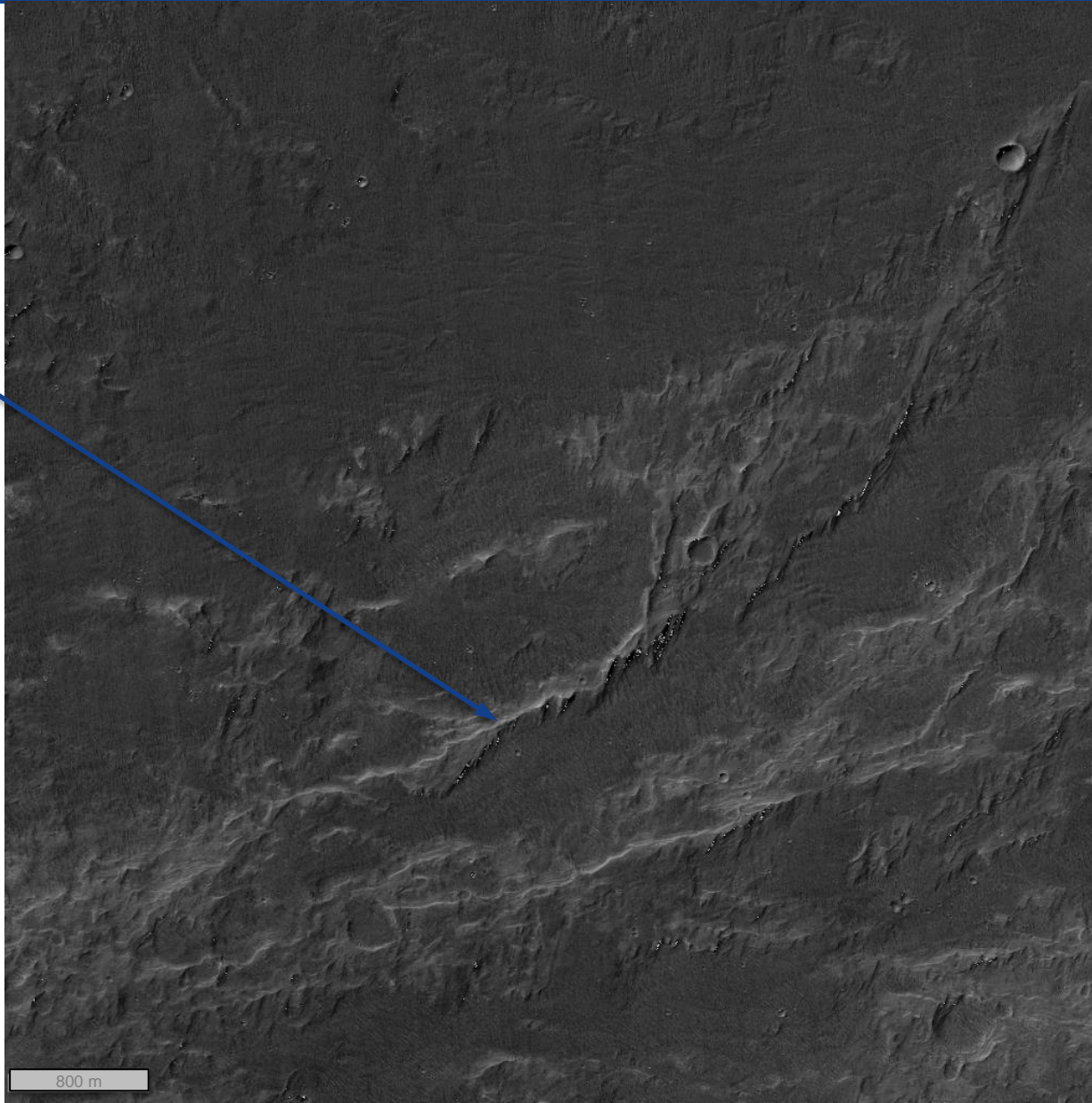


Smooth rock
with sand
coverage

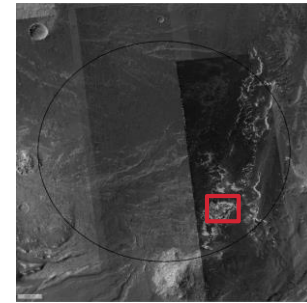
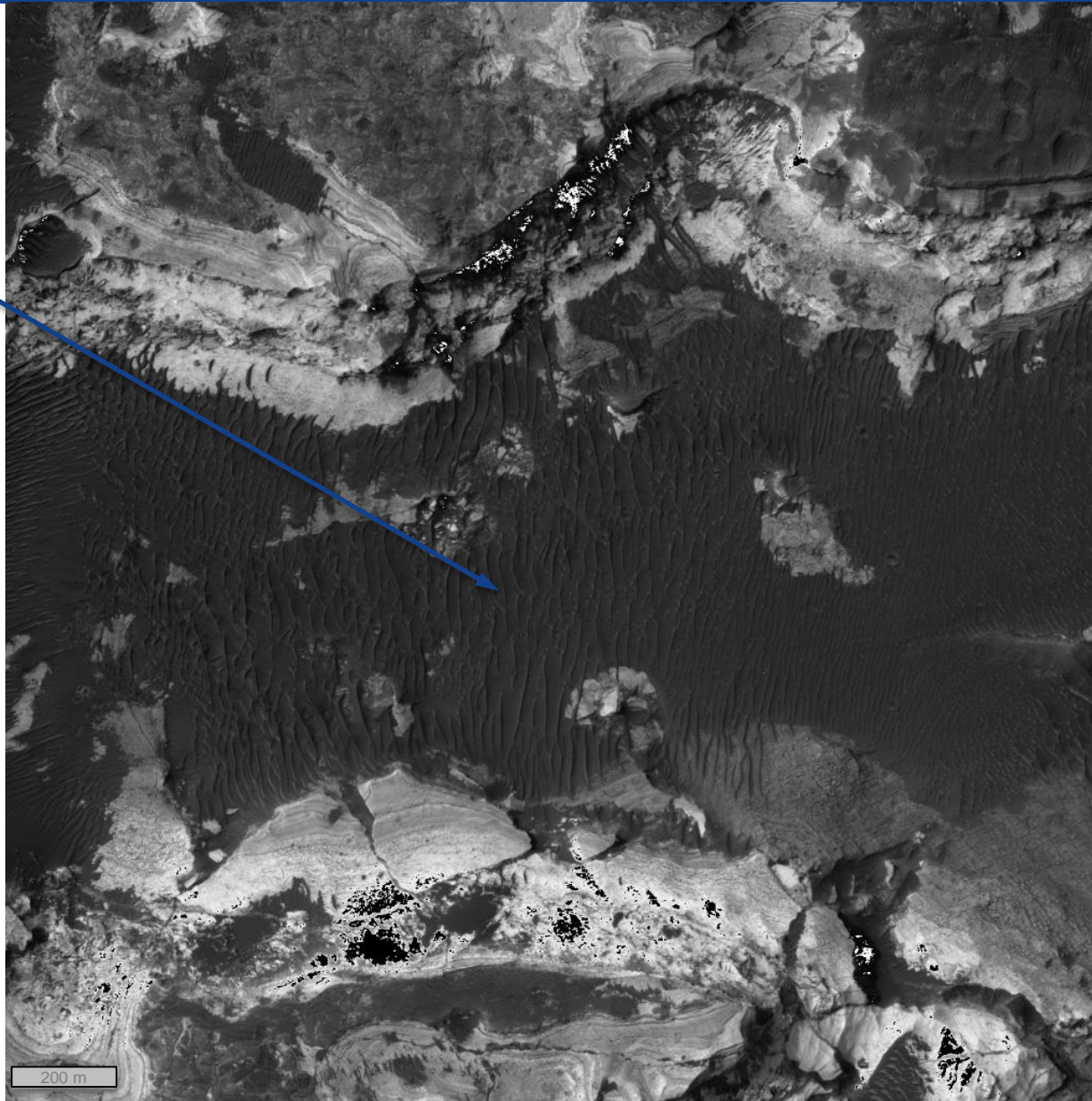
Traversable but
slow going



Large scale
linear features
that are
potentially
difficult to pass



Valleys with
potentially non-
traversable
sand



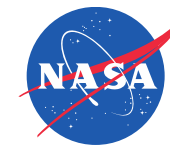
Scorecard



Jet Propulsion Laboratory
California Institute of Technology

Mars 2020 Project

Site	Score	Comments
Gale Crater	5	Only considering the area driven by Curiosity
Northeast Syrtis Major	3	Lots of obstacles, but smooth areas around
Jezero	8	Lots of rocks and lots of sand
Nili Fossae Trough	2	Smooth terrain with some sand
Holden	7	sand over smooth outcrop with potentially non-traversable sand in canyons
McLaughlin Crater	3	Thin sand over smooth bedrock, but lots of rocks in the north
Southwest Melas Basin	6	North polygonal ripples, middle stairs, south easy driving
Mawrth	7	Most of the site is rough outcrop with some large untraversable craters
East Margaritifer Terra	4	Bedrock covered by traversable sand ripples

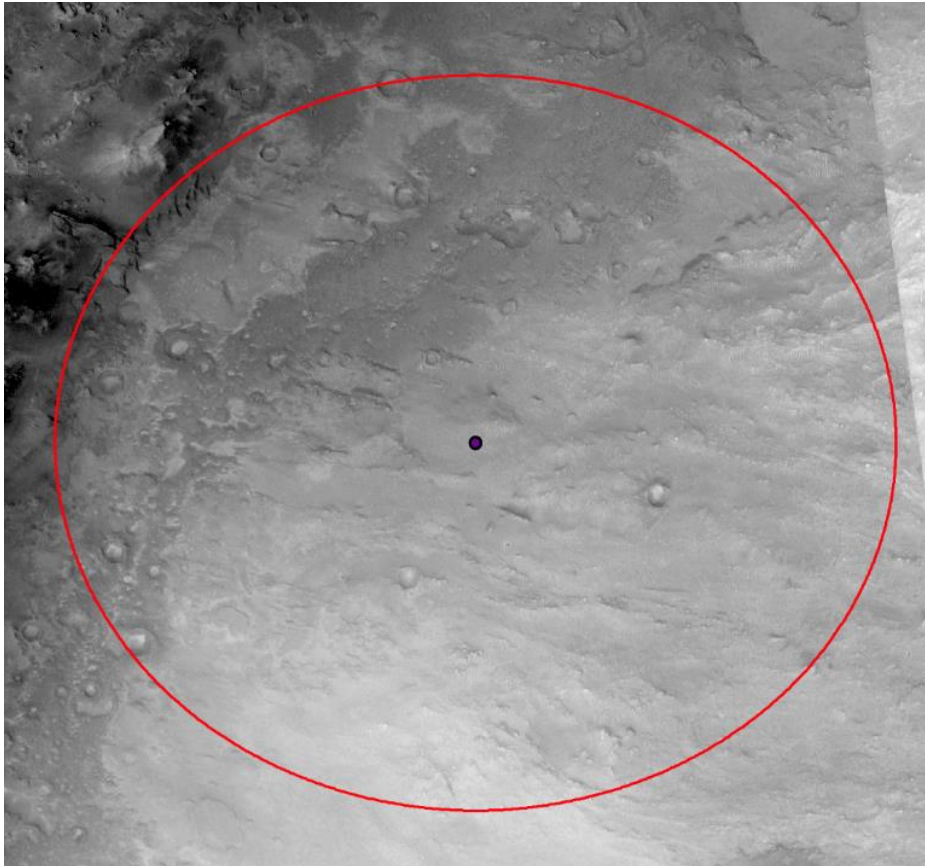


Jet Propulsion Laboratory
California Institute of Technology

Mars 2020 Project

Backup

- Traversability rating 2 / 10 (more traversable than Gale)
 - Smooth terrain with sparse sand coverage

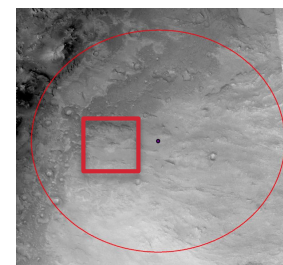
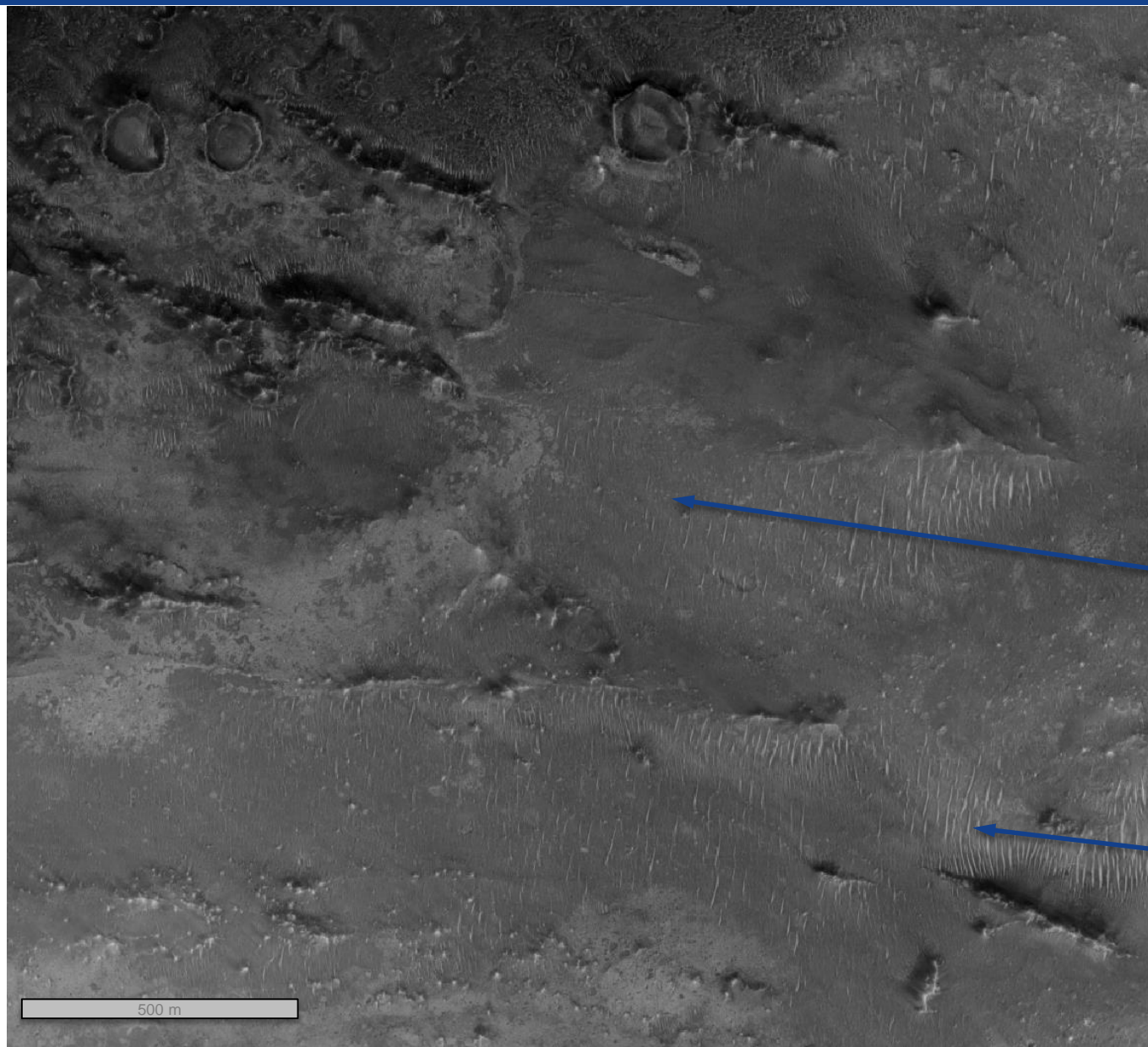


Nili Fossae Trough



Jet Propulsion Laboratory
California Institute of Technology

Mars 2020 Project



Smooth easy
driving

Shallow and
sparse sand

2

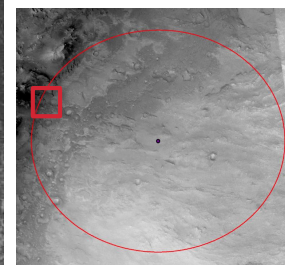
Mars 2020 Project-20

Nili Fossae Trough

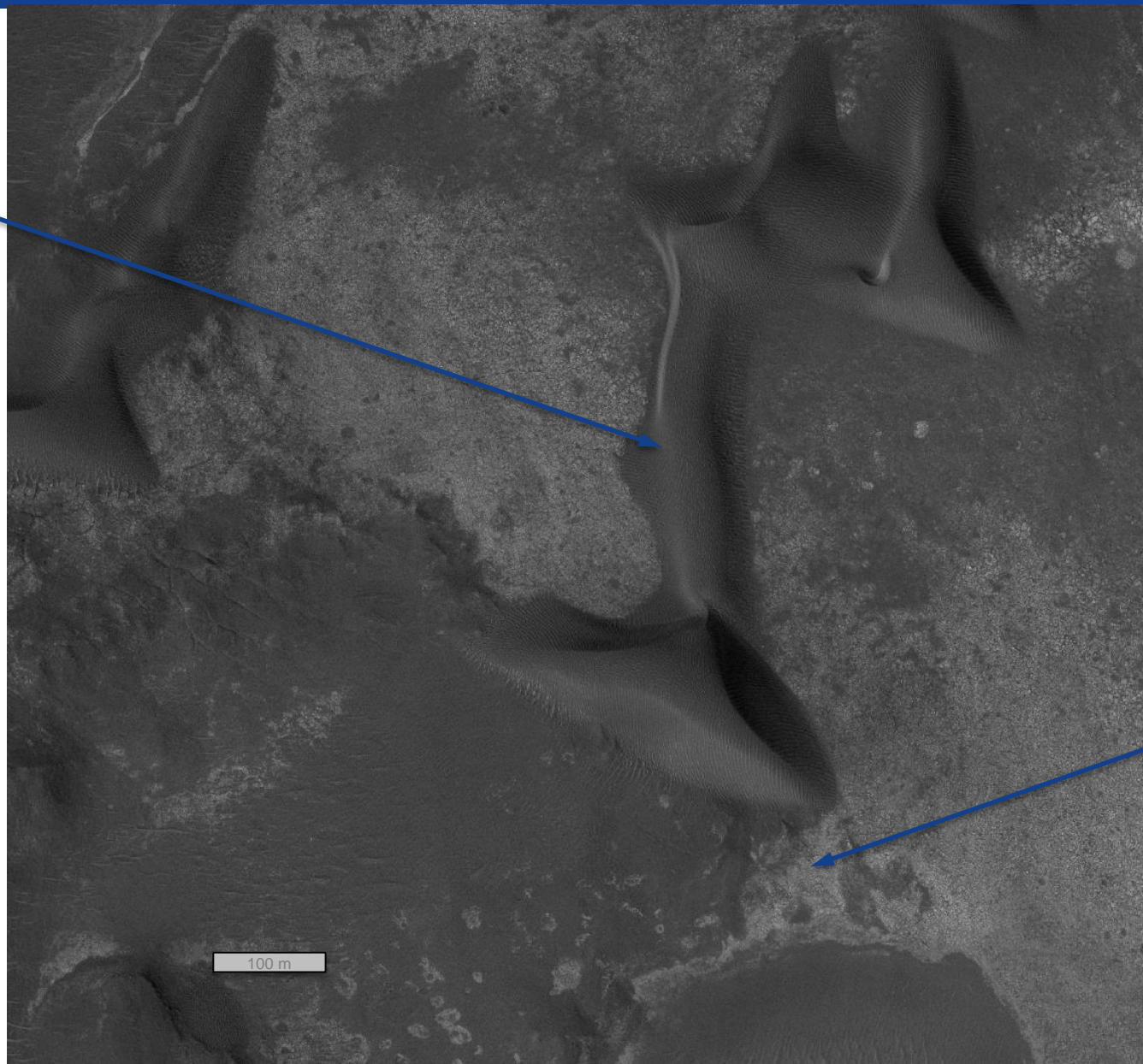


Jet Propulsion Laboratory
California Institute of Technology

Mars 2020 Project



Large sand
dunes



A handful of
traversable
options through
the dunes

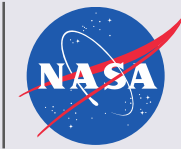
2

Mars 2020 Project-21

- Traversability rating of 8 / 10 (less traversable than Gale)
 - Lots of rocks
 - Lots of sand accumulations
 - Not much smooth terrain



Jezero

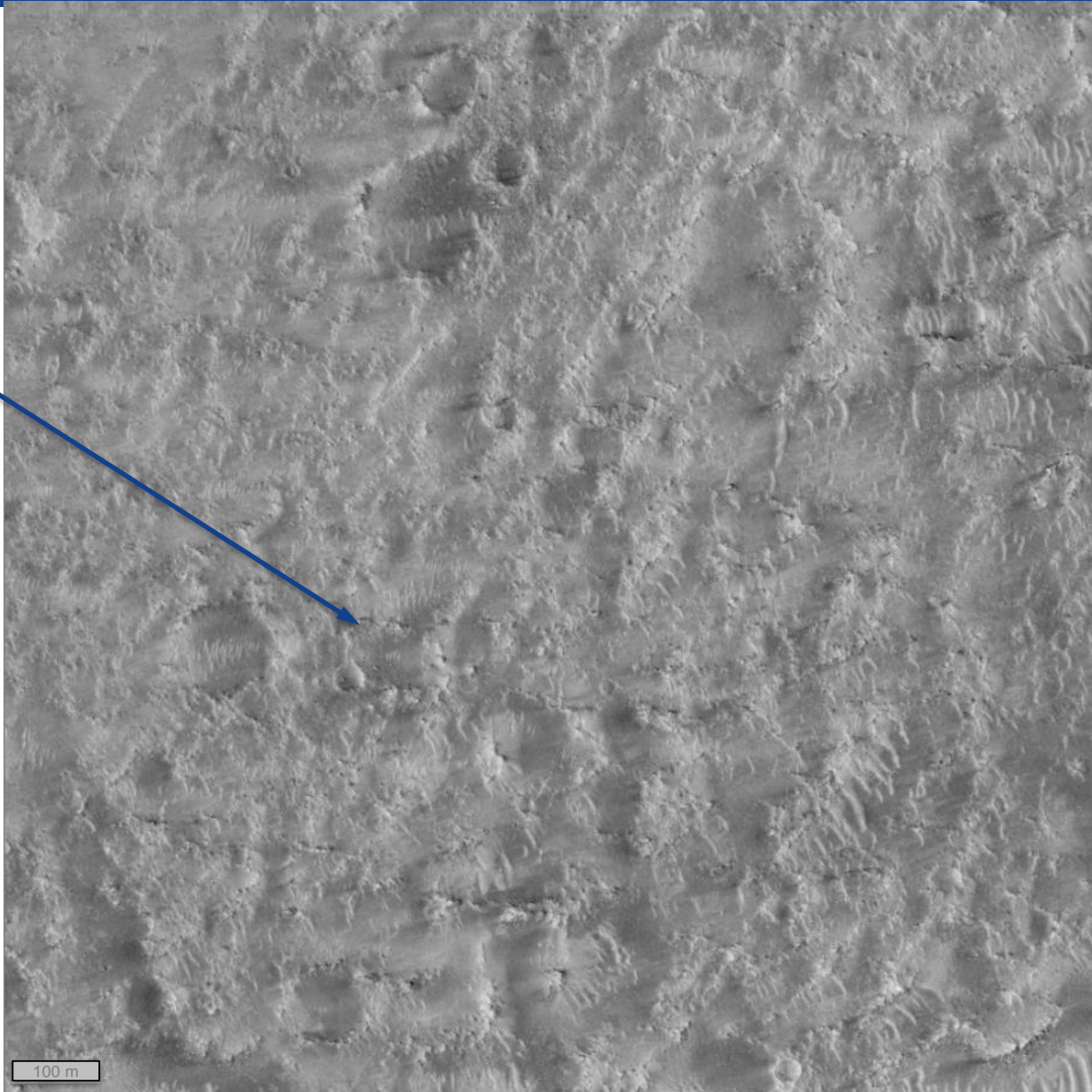
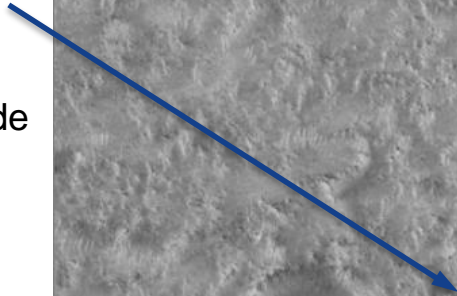


Jet Propulsion Laboratory
California Institute of Technology

Mars 2020 Project

Lots of rocks.

Particularly
prevalent on
the eastern side
of the ellipse



Jezero

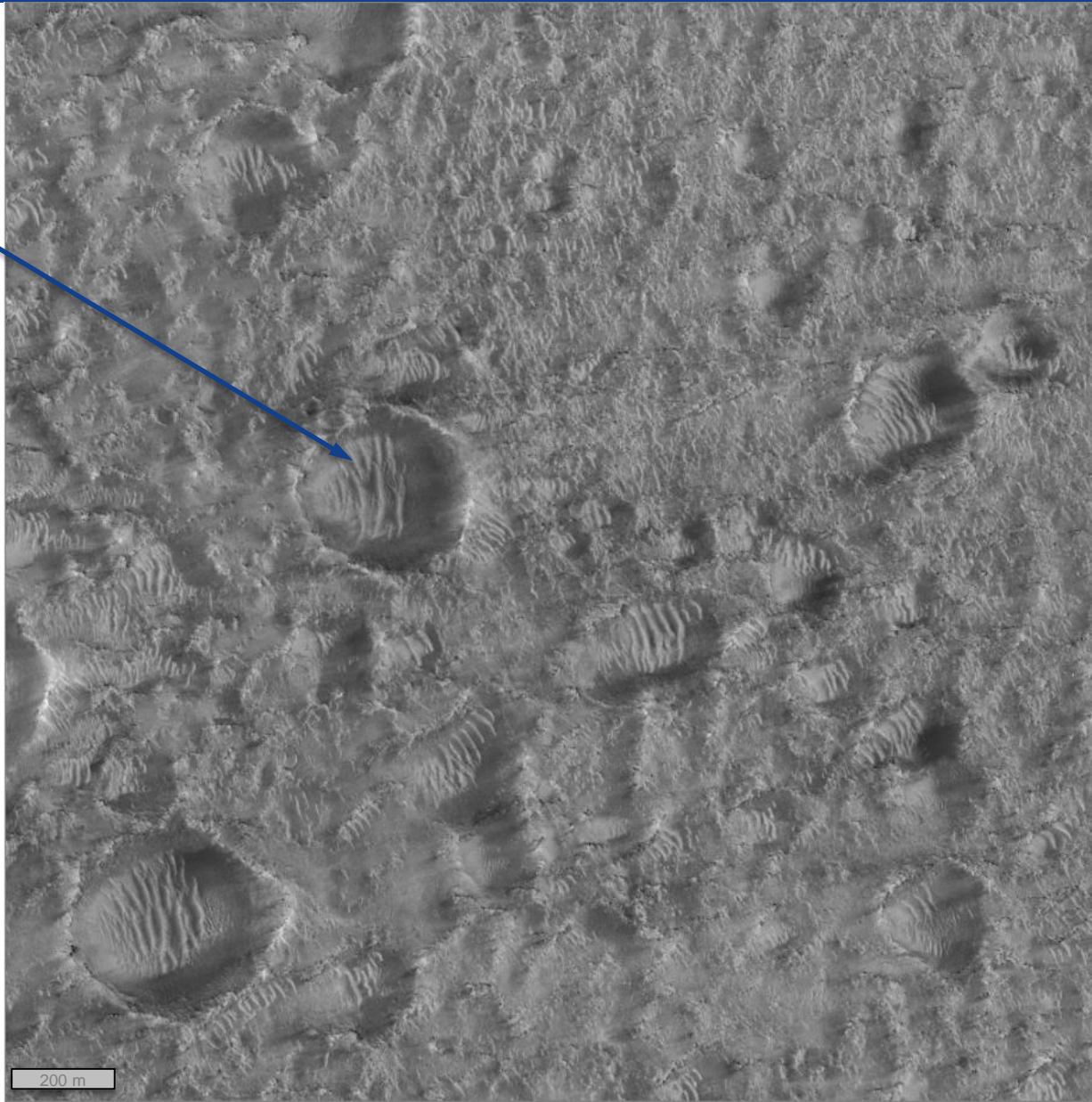


Jet Propulsion Laboratory
California Institute of Technology

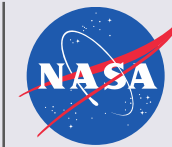
Mars 2020 Project

Frequent
craters with
sand
accumulations.

Particularly
prevalent on
the eastern side
of the ellipse



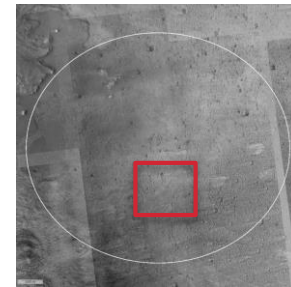
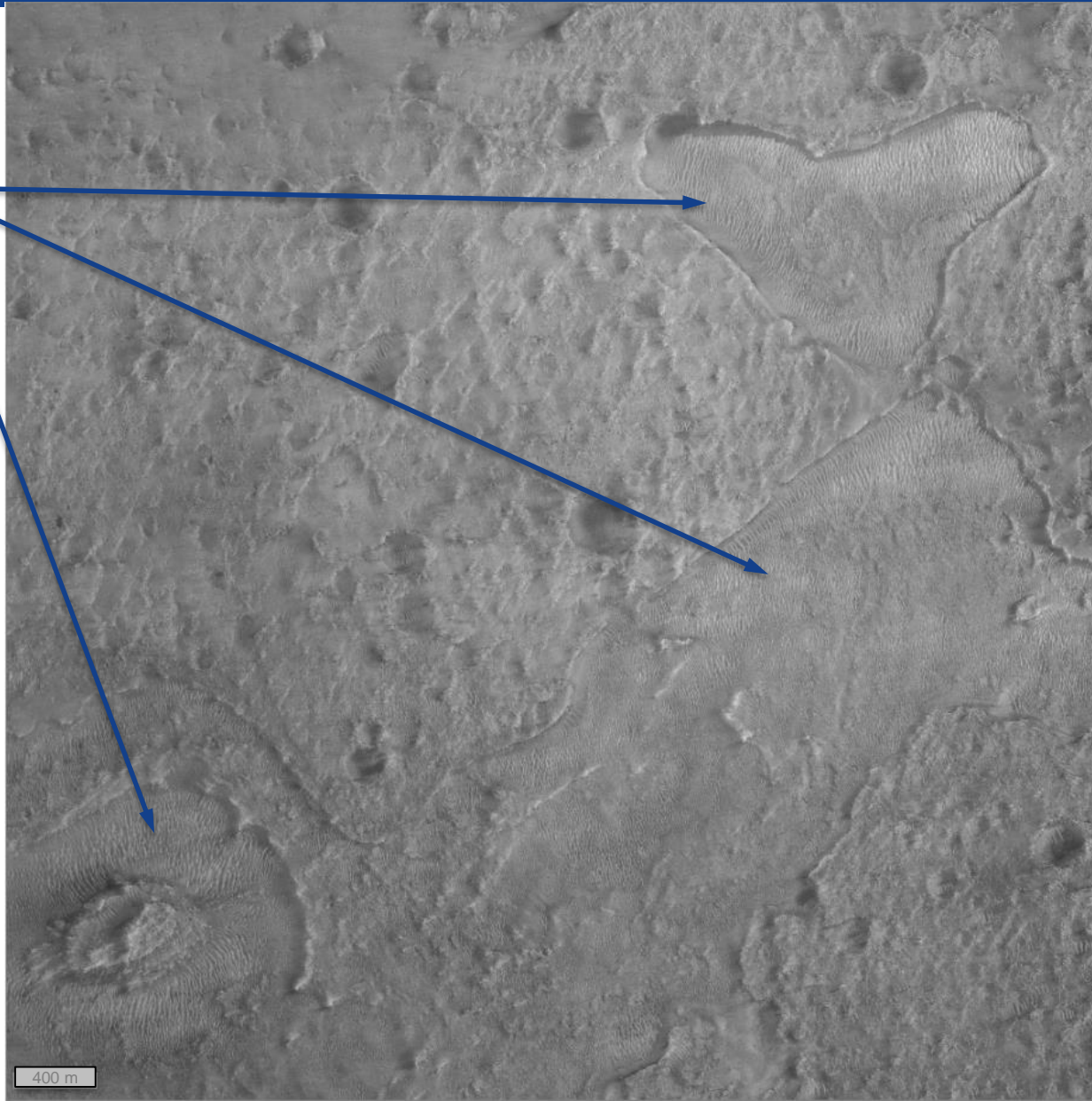
Jezero



Jet Propulsion Laboratory
California Institute of Technology

Mars 2020 Project

Large scale
features with
complex sand
accumulations



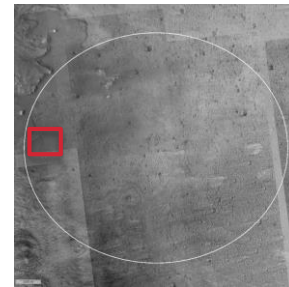
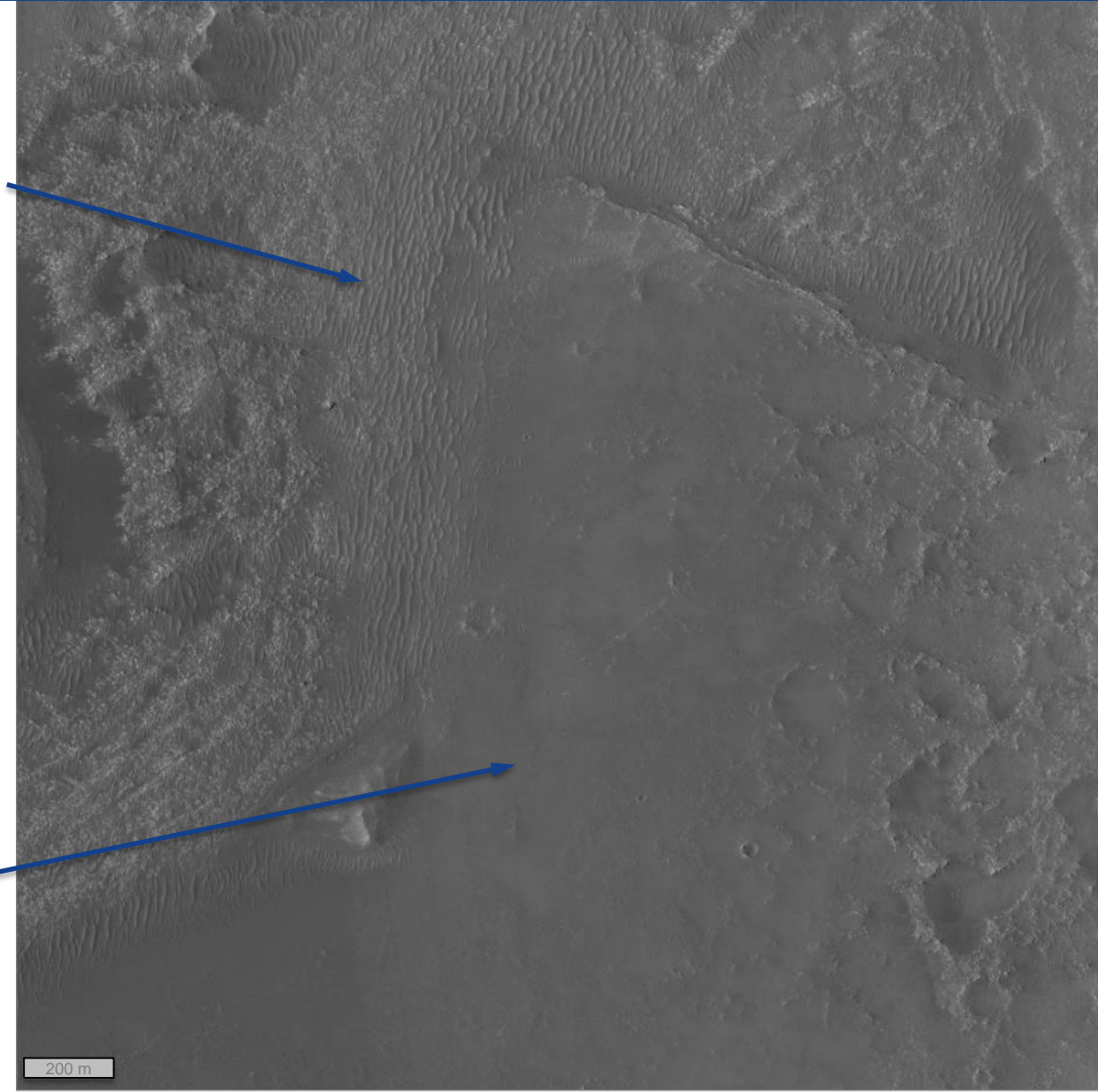
Jezero



Jet Propulsion Laboratory
California Institute of Technology

Mars 2020 Project

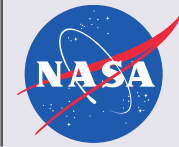
Passable sand



Smooth easy
driving

Overall easier
driving as you
go west

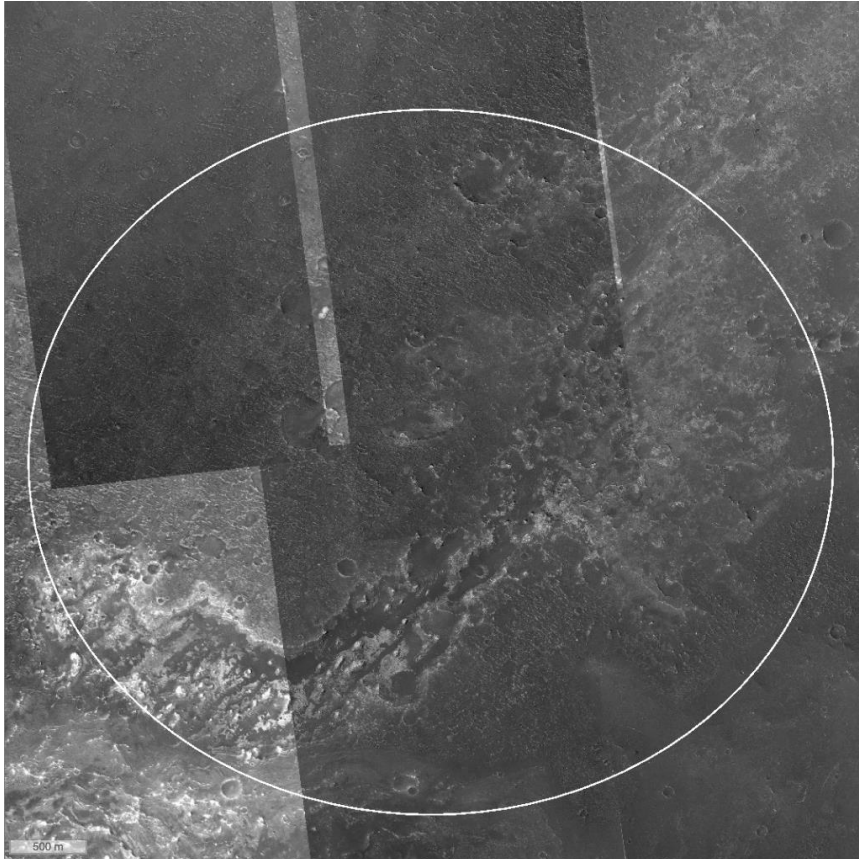
McLaughlin Crater



Jet Propulsion Laboratory
California Institute of Technology

Mars 2020 Project

- Traversability rating of 3 / 10 (more traversable than Gale)
 - Easily traversable smooth thin sand over bedrock
 - Lots of rocks in the northern part of the ellipse



McLaughlin Crater

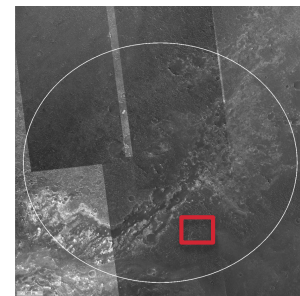
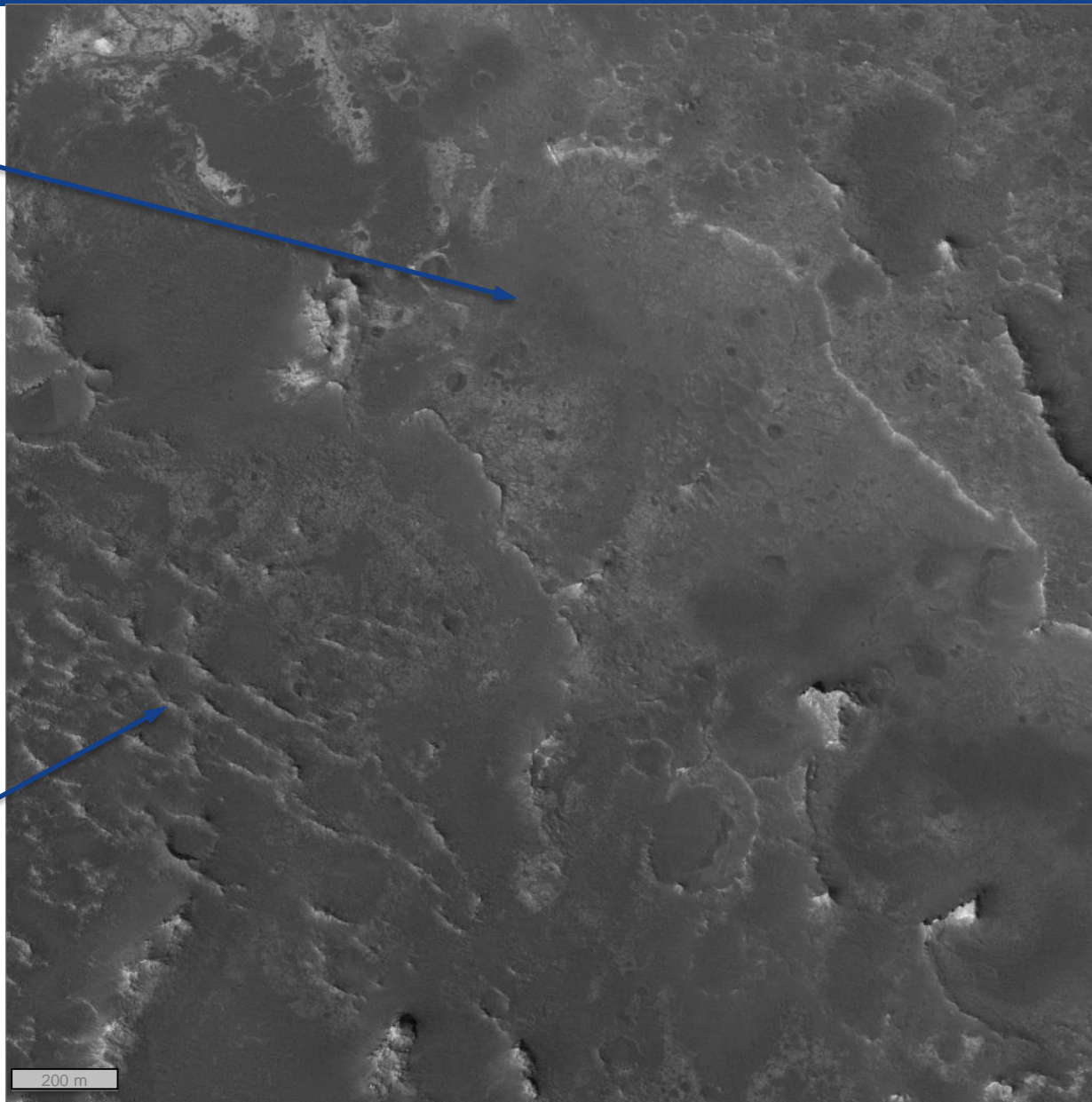


Jet Propulsion Laboratory
California Institute of Technology

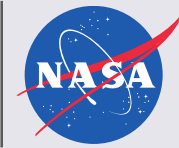
Mars 2020 Project

Thin layer of
traversable
sand

Ridge features
with traversable
routes around



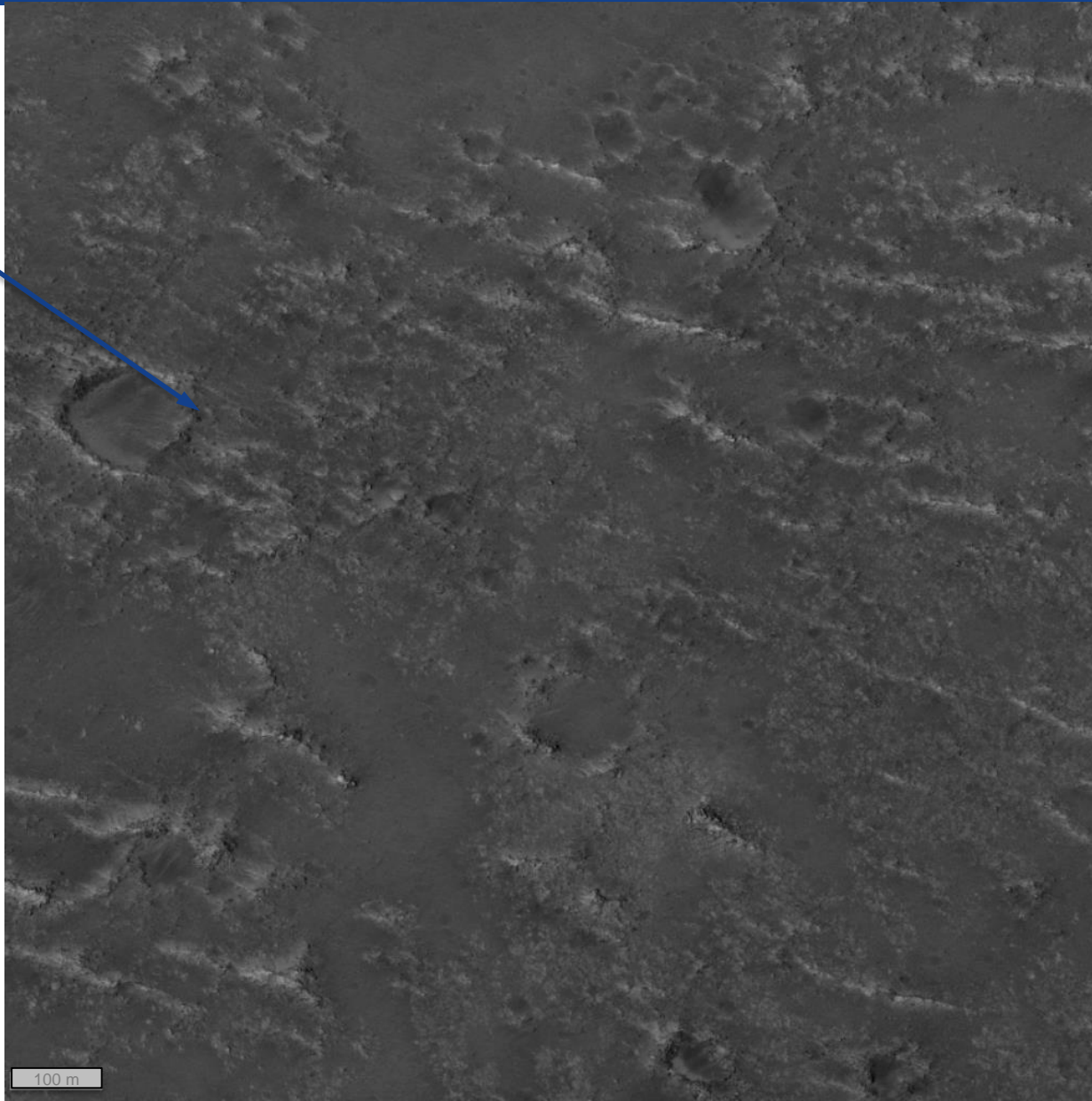
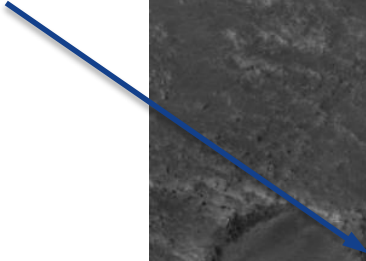
McLaughlin Crater



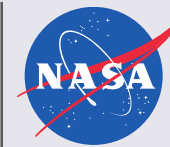
Jet Propulsion Laboratory
California Institute of Technology

Mars 2020 Project

Lots of rocks
in the northern
part of the
ellipse



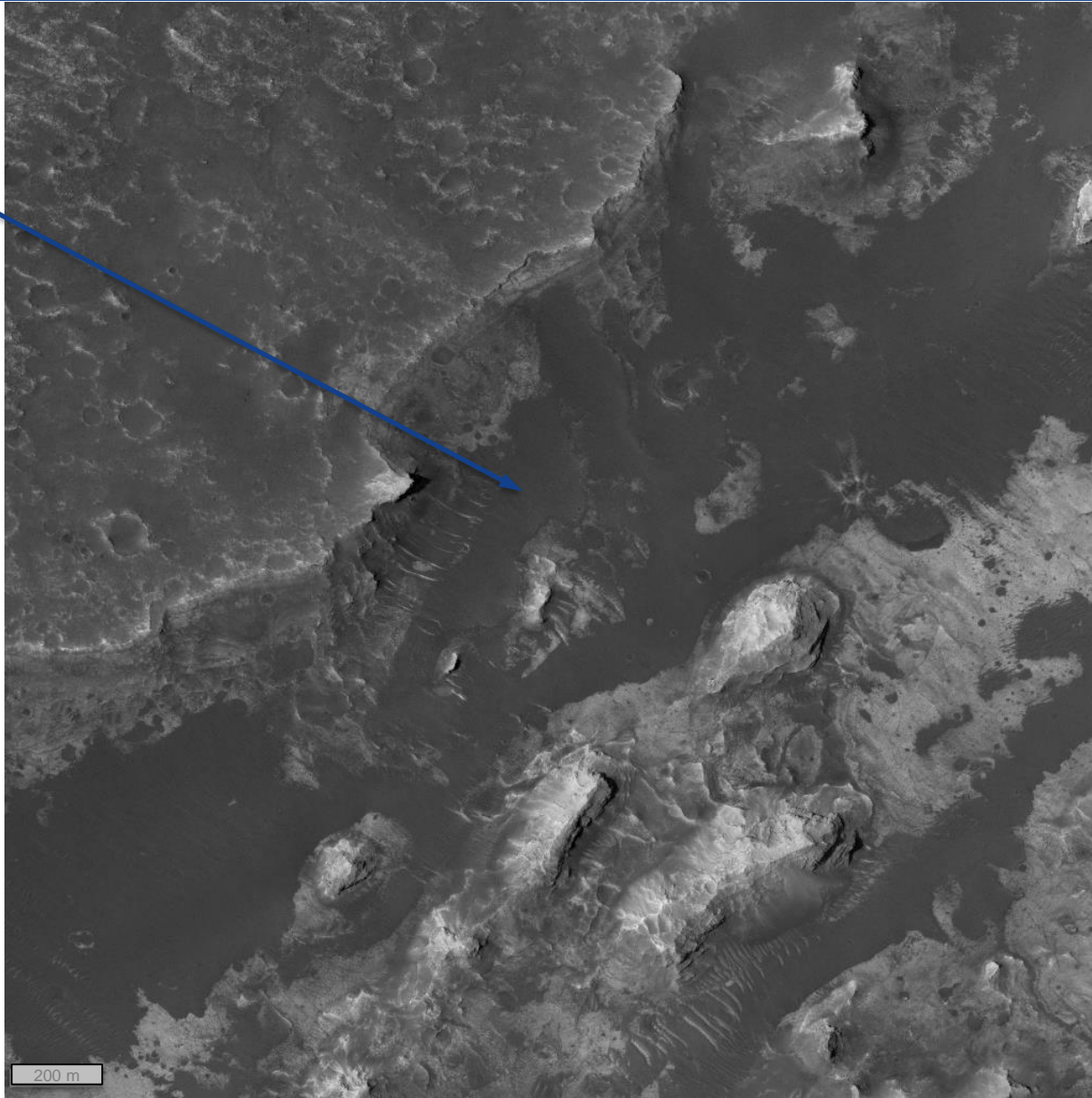
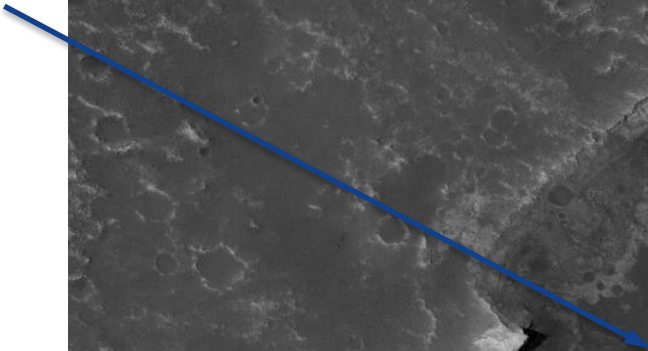
McLaughlin Crater



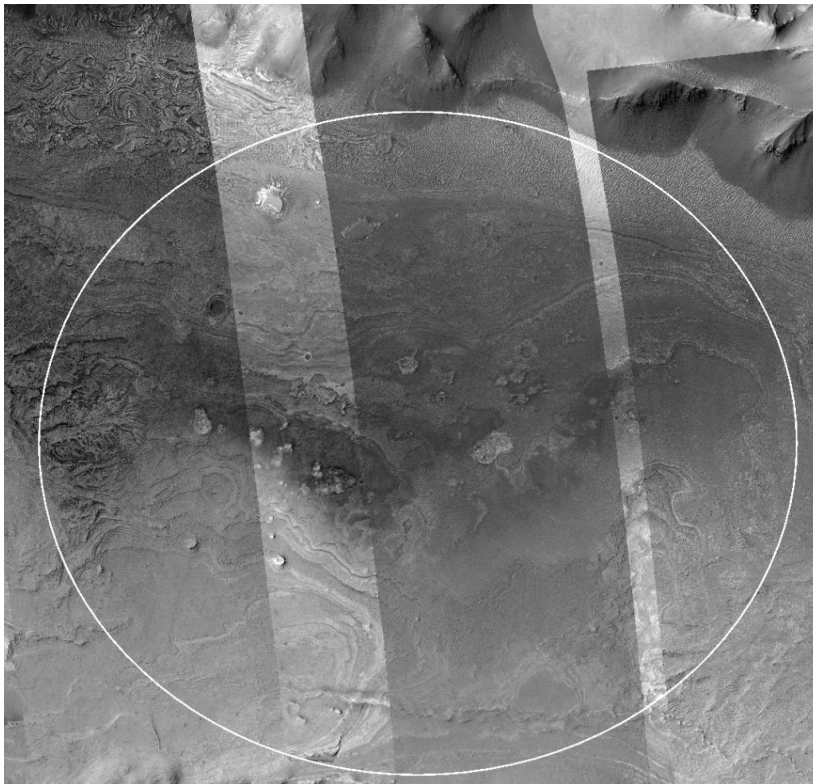
Jet Propulsion Laboratory
California Institute of Technology

Mars 2020 Project

Sand
accumulations
in valleys
looks
traversable



- Traversability rating of 6 / 10 (less traversable than Gale)
 - Northern part of the ellipse is non-traversable due to sand
 - Southern part of the ellipse is pretty easy driving
 - Middle portion of the ellipse is quite challenging



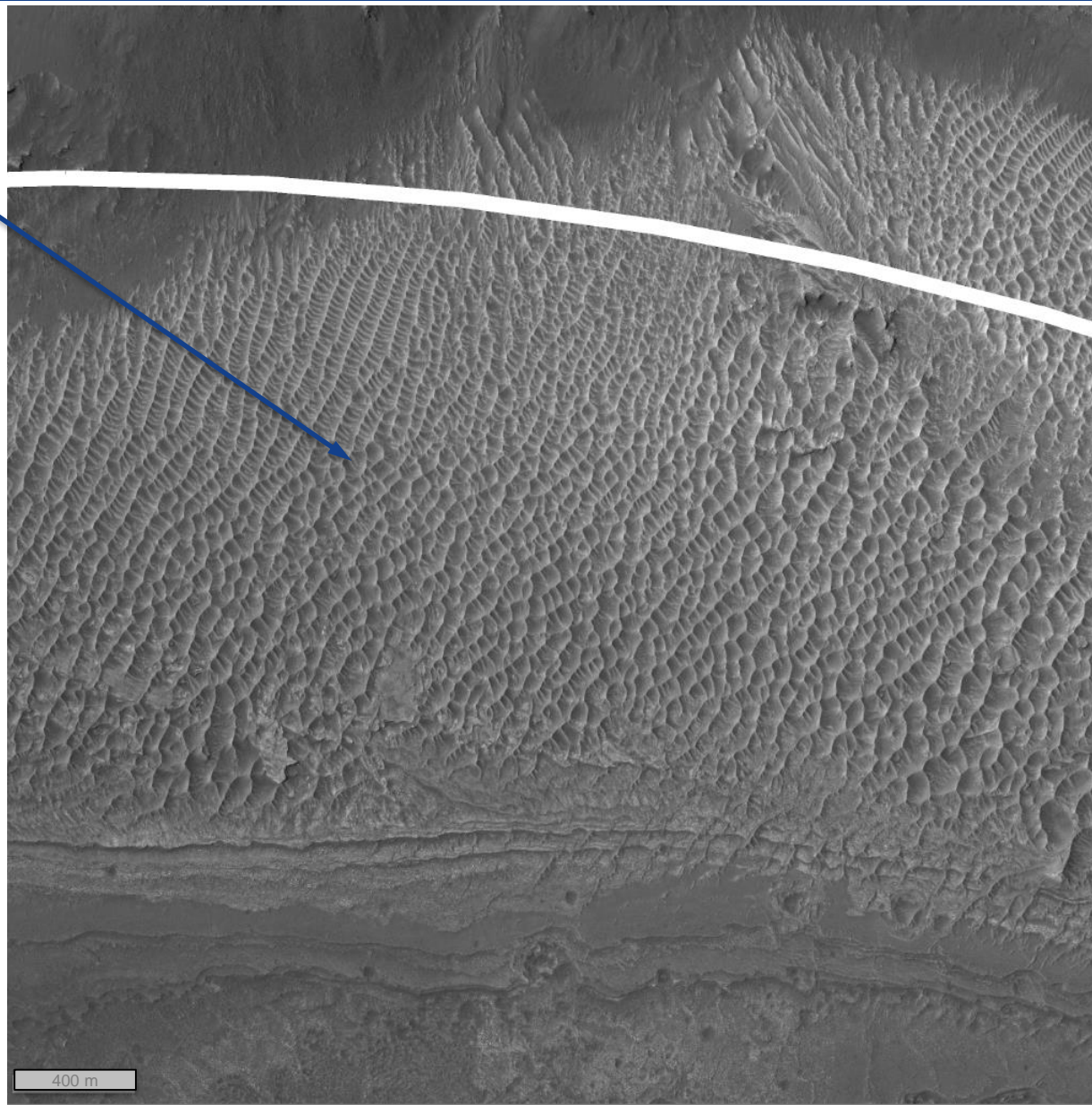
Southwest Melas Basin



Jet Propulsion Laboratory
California Institute of Technology

Mars 2020 Project

Non-traversable
polygonal sand
ripples across
the top of the
landing ellipse



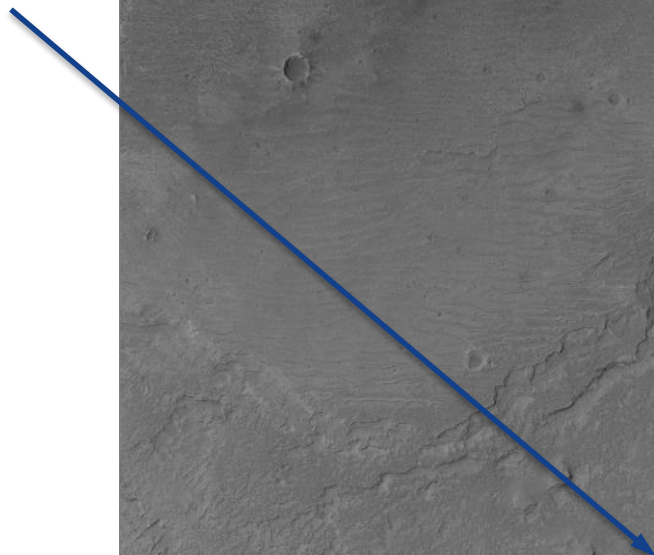
Southwest Melas Basin



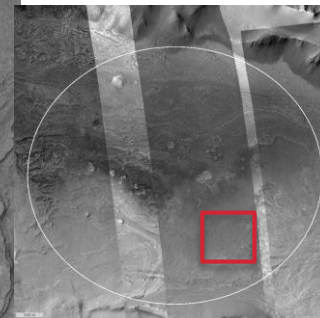
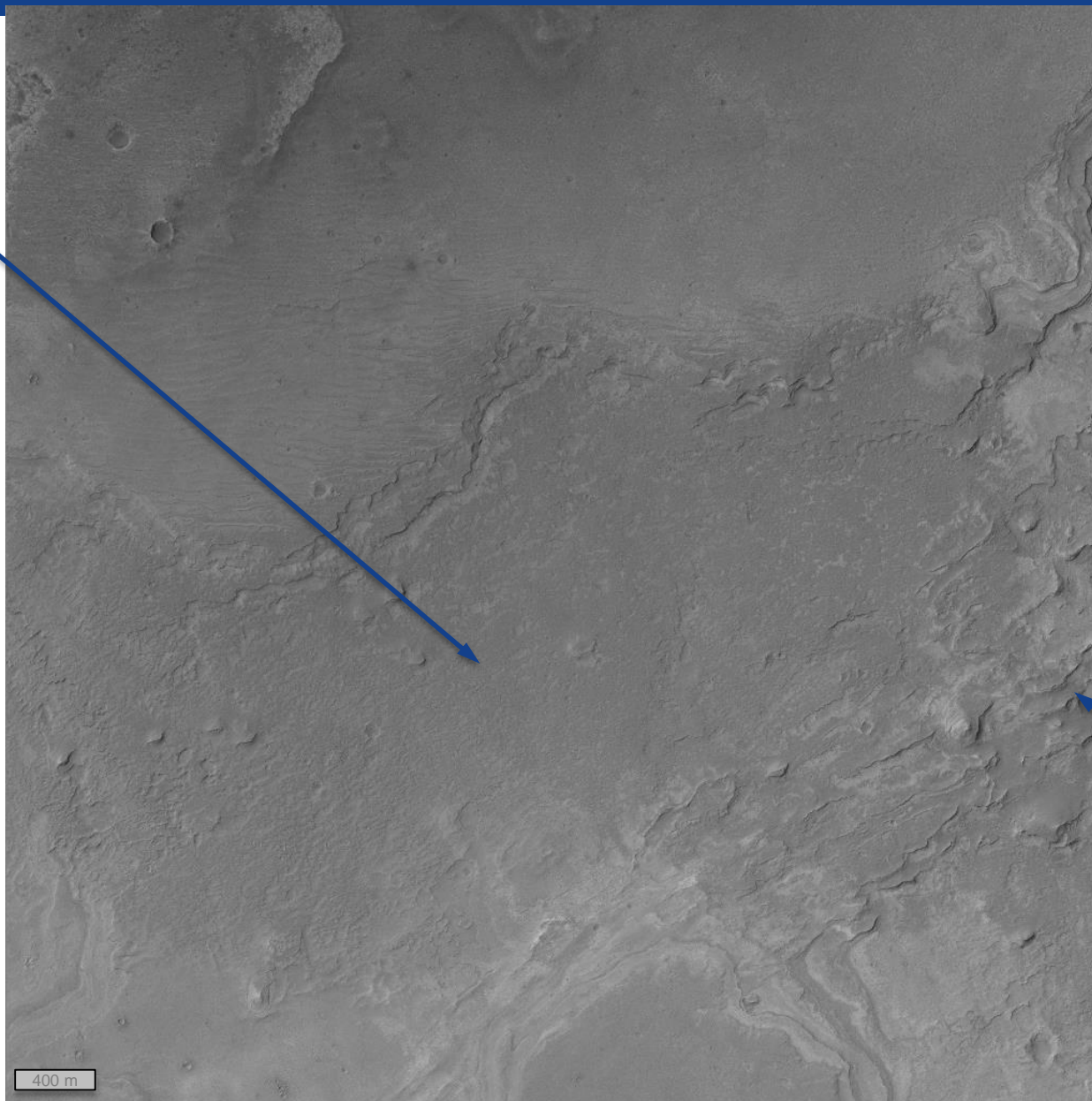
Jet Propulsion Laboratory
California Institute of Technology

Mars 2020 Project

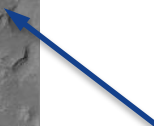
Moderately
smooth outcrop



Southern
portion of the
ellipse is
relatively
traversable



Scarps with
circuitous
routes through



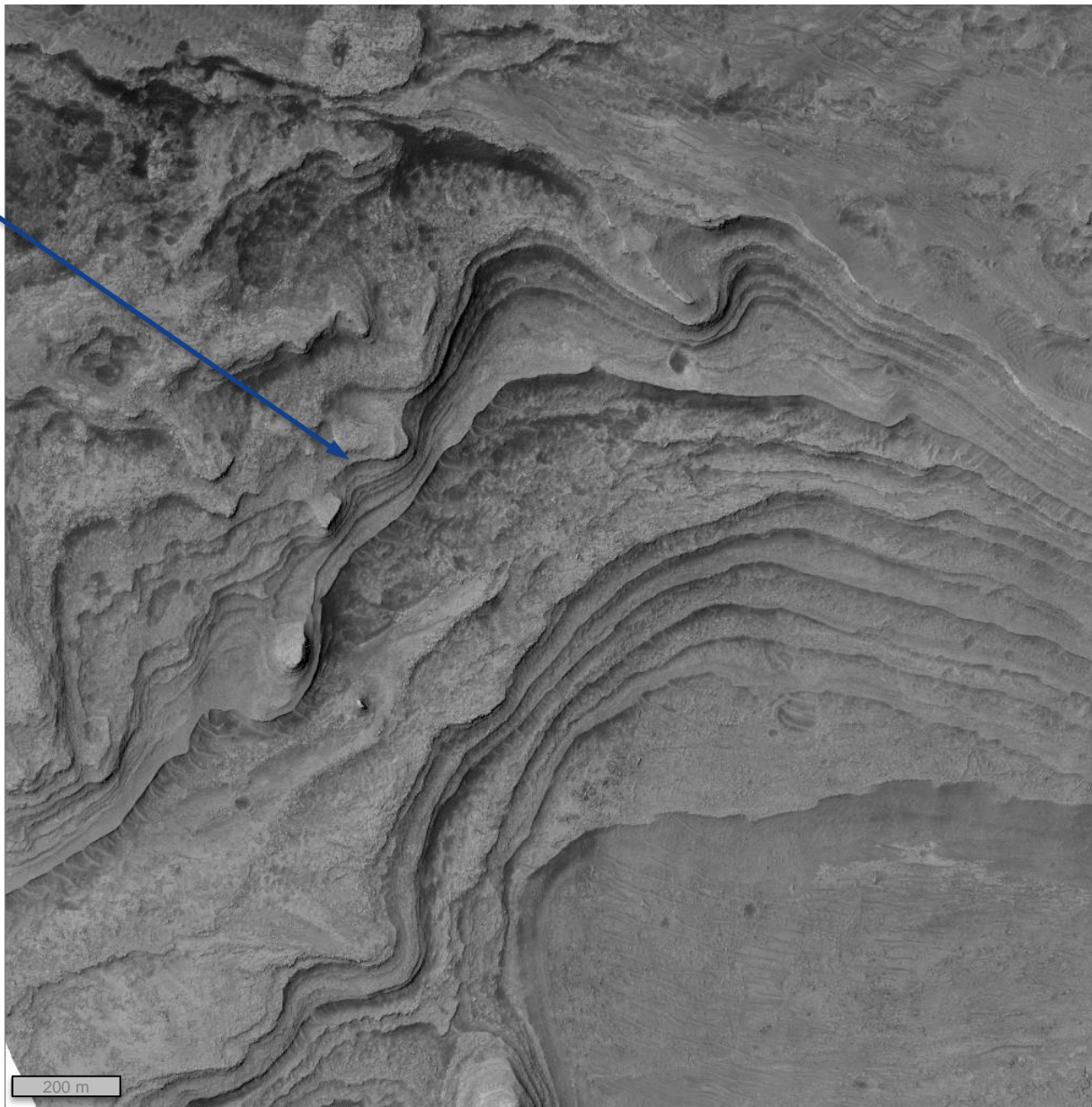
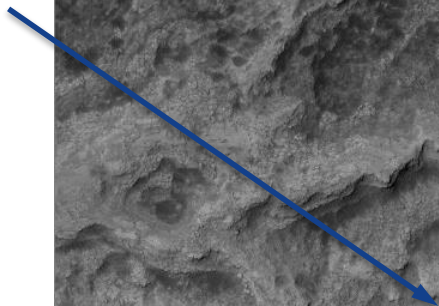
Southwest Melas Basin



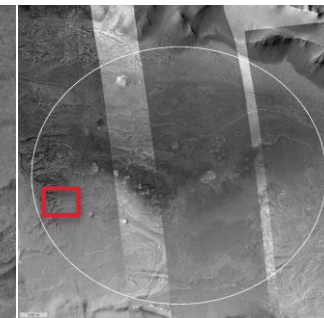
Jet Propulsion Laboratory
California Institute of Technology

Mars 2020 Project

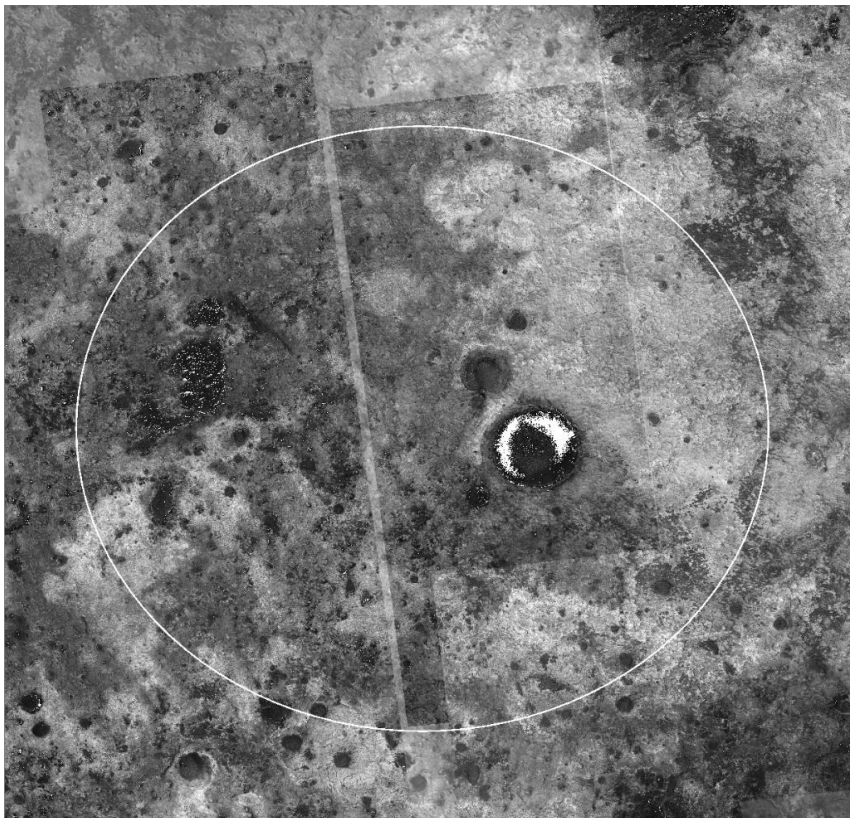
Stair-stepped
features with
significant
elevation
change



200 m



- Traversability rating of 7 / 10 (less traversable than Gale)
 - Large craters with potentially non-traversable sand
 - Most of the site is rough, undulating outcrop



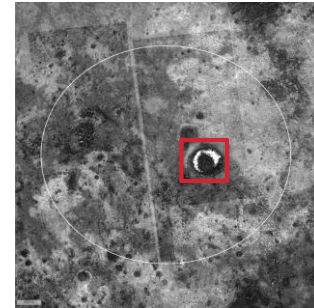
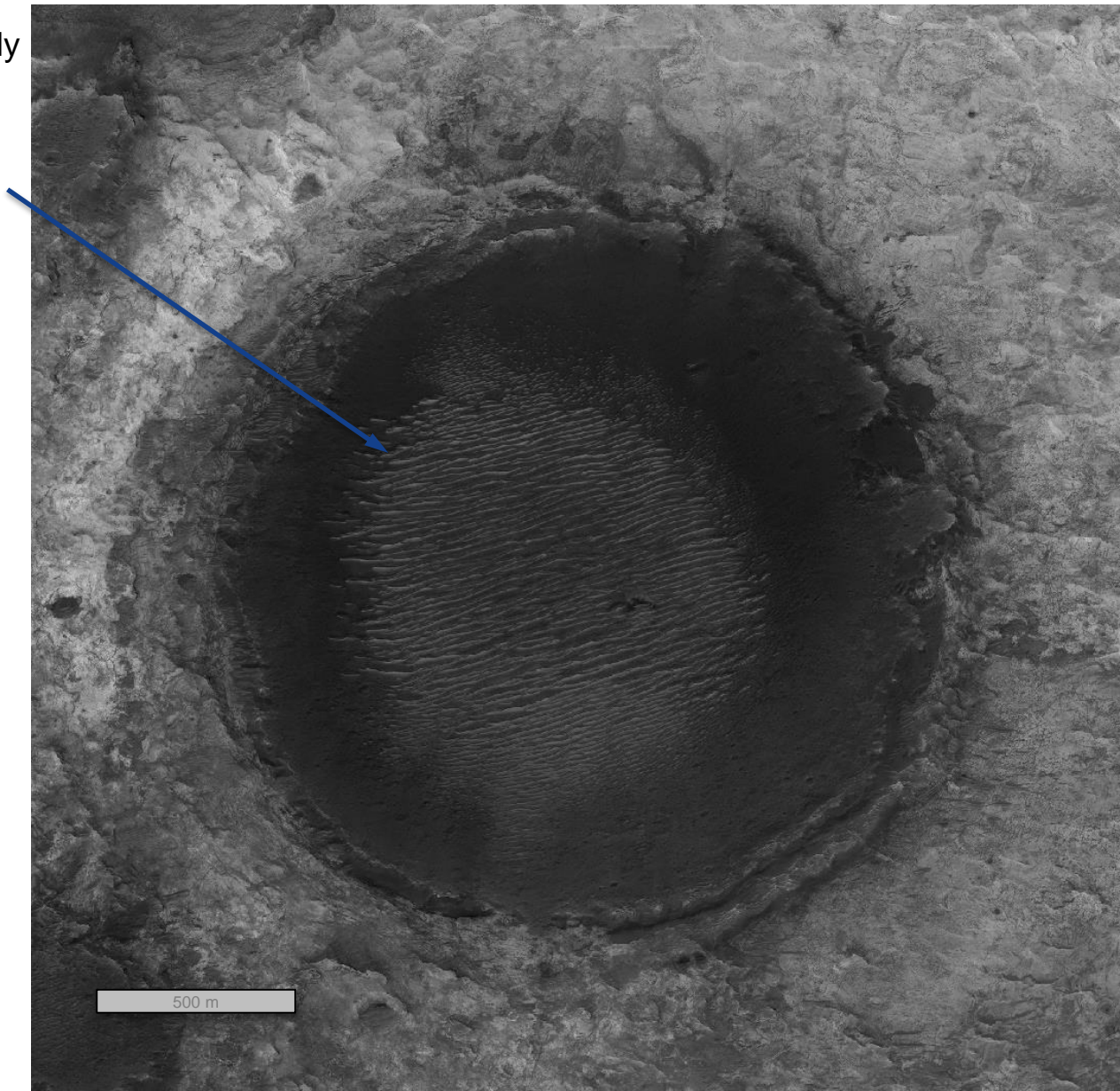
Mawrth



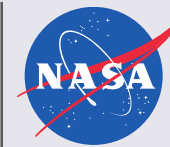
Jet Propulsion Laboratory
California Institute of Technology

Mars 2020 Project

Large, potentially
non-traversable
craters

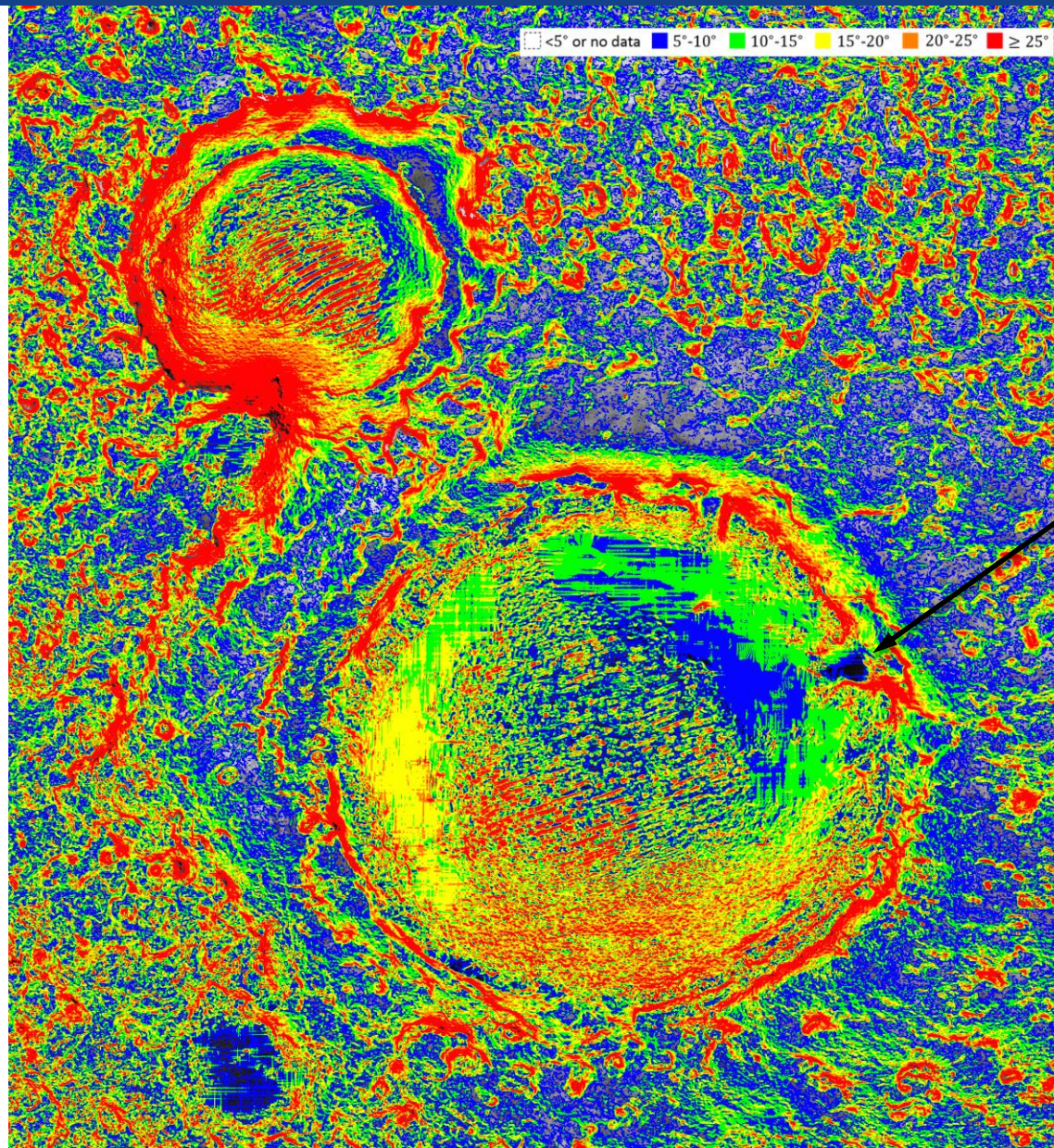


Mawrth (slope map of crater on previous slide)



Jet Propulsion Laboratory
California Institute of Technology

Mars 2020 Project



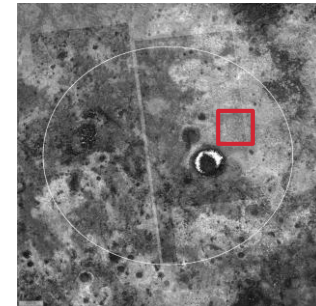
Escape routes
with low slope if
sand at basin is
traversable

Mawrth

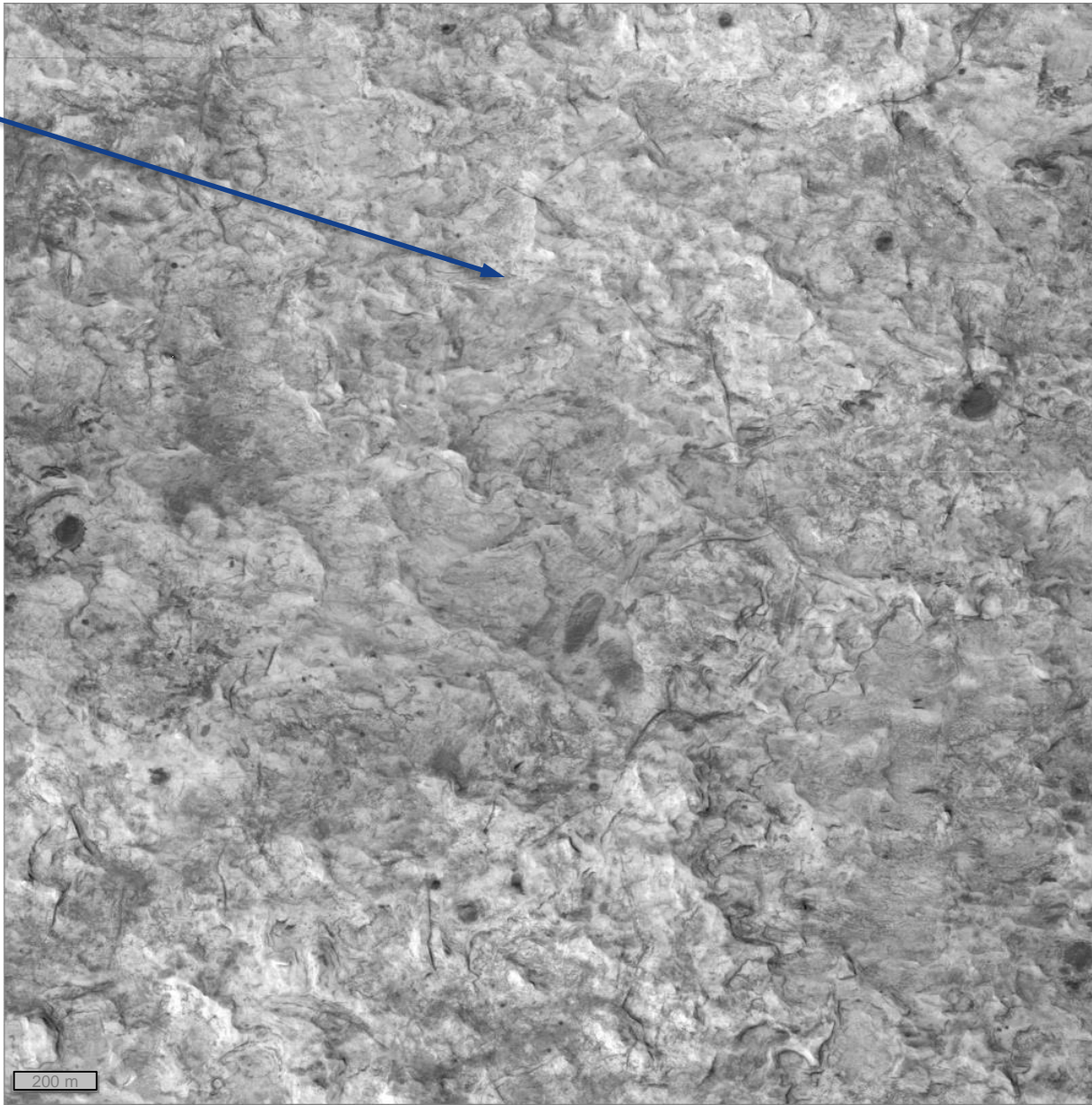


Jet Propulsion Laboratory
California Institute of Technology

Mars 2020 Project



Rough fractured
and eroded
outcrop with
undulation



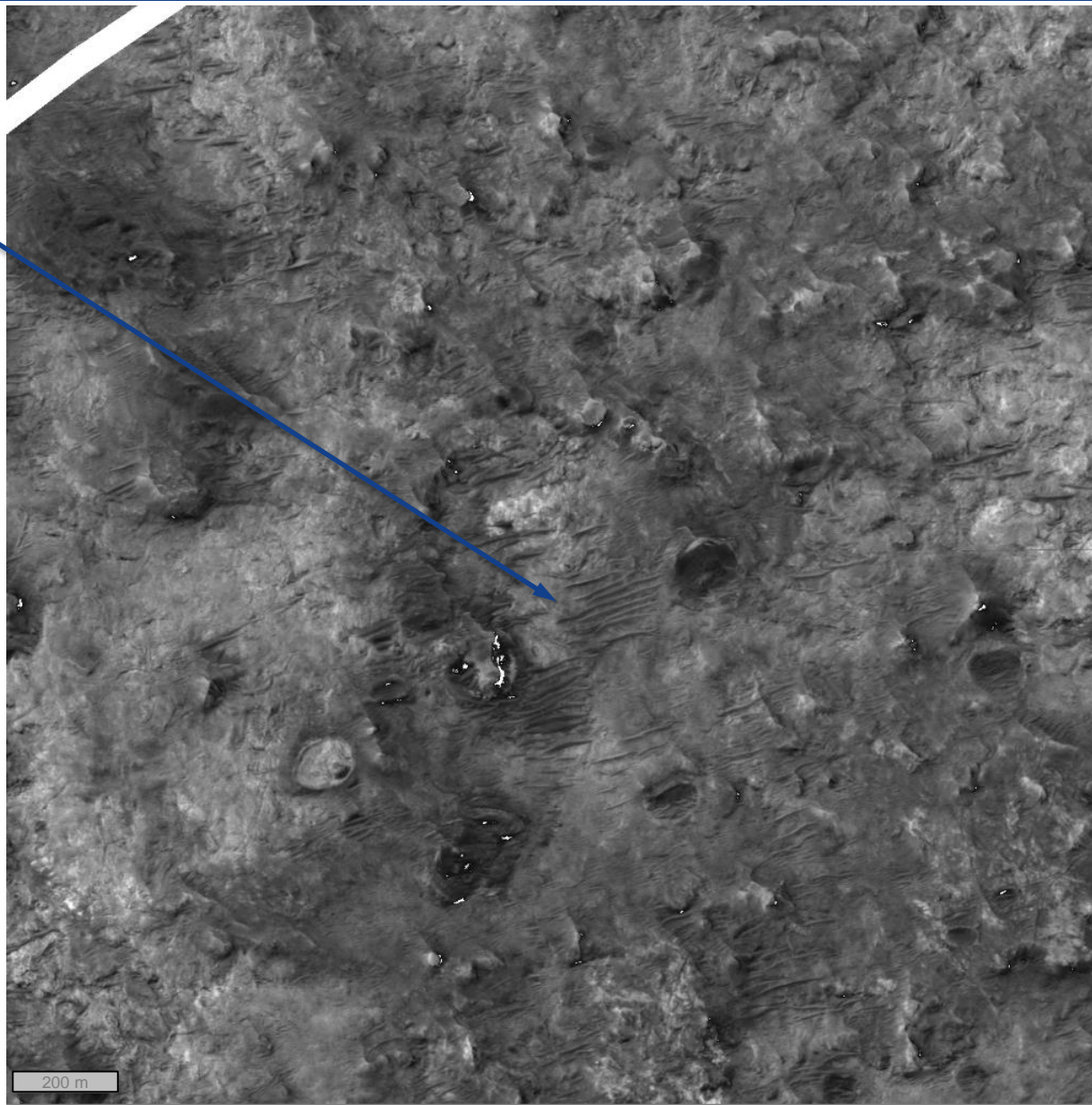
Mawrth



Jet Propulsion Laboratory
California Institute of Technology

Mars 2020 Project

Outcrop with
sparse
occasional sand
accumulation



- Traversability rating of 4 / 10 (more traversable than Gale)
 - High areas are smooth bedrock covered by sparse sand
 - Low areas are fractured bedrock and have some rocks with more frequent but traversable sand ripples
 - Some areas of non-traversable sand, but ways around them



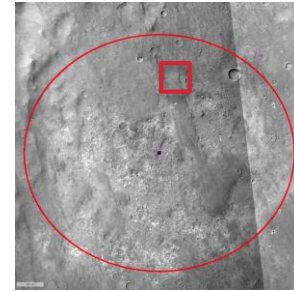
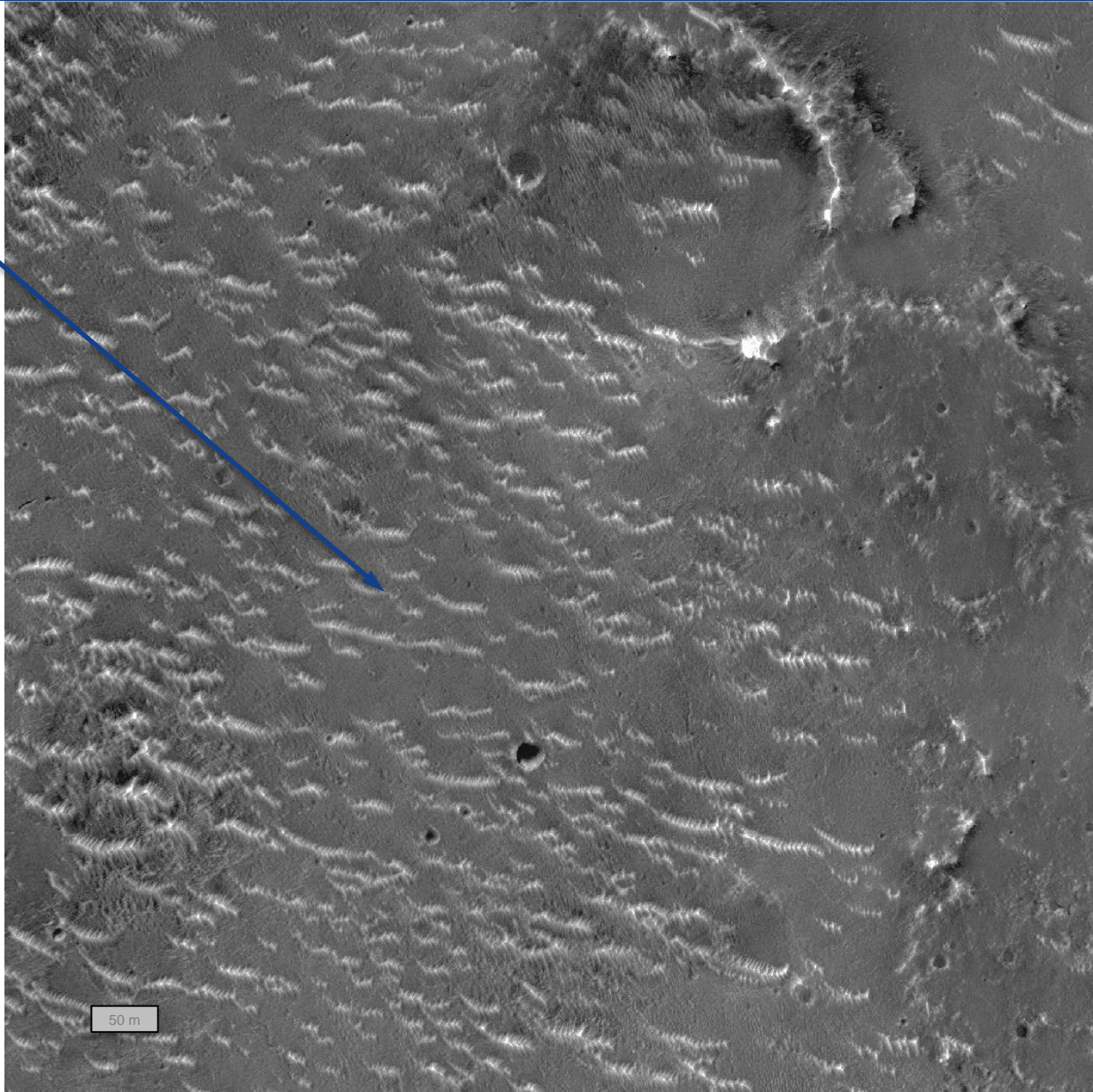
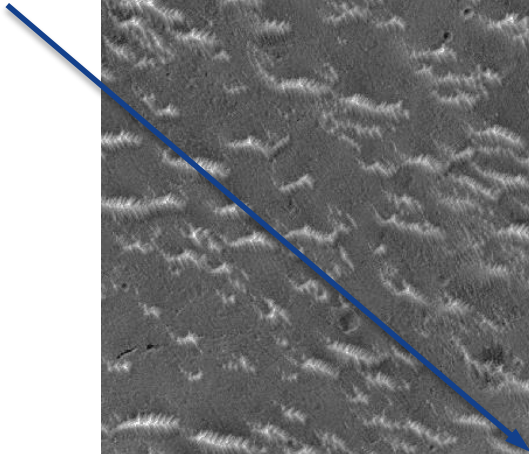
East Margaritifer Terra



Jet Propulsion Laboratory
California Institute of Technology

Mars 2020 Project

Sparse sand on
firm underlying
terrain, easily
traversable



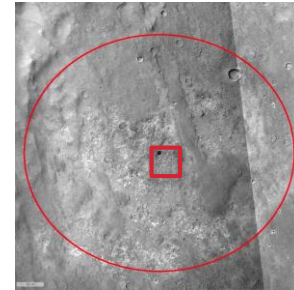
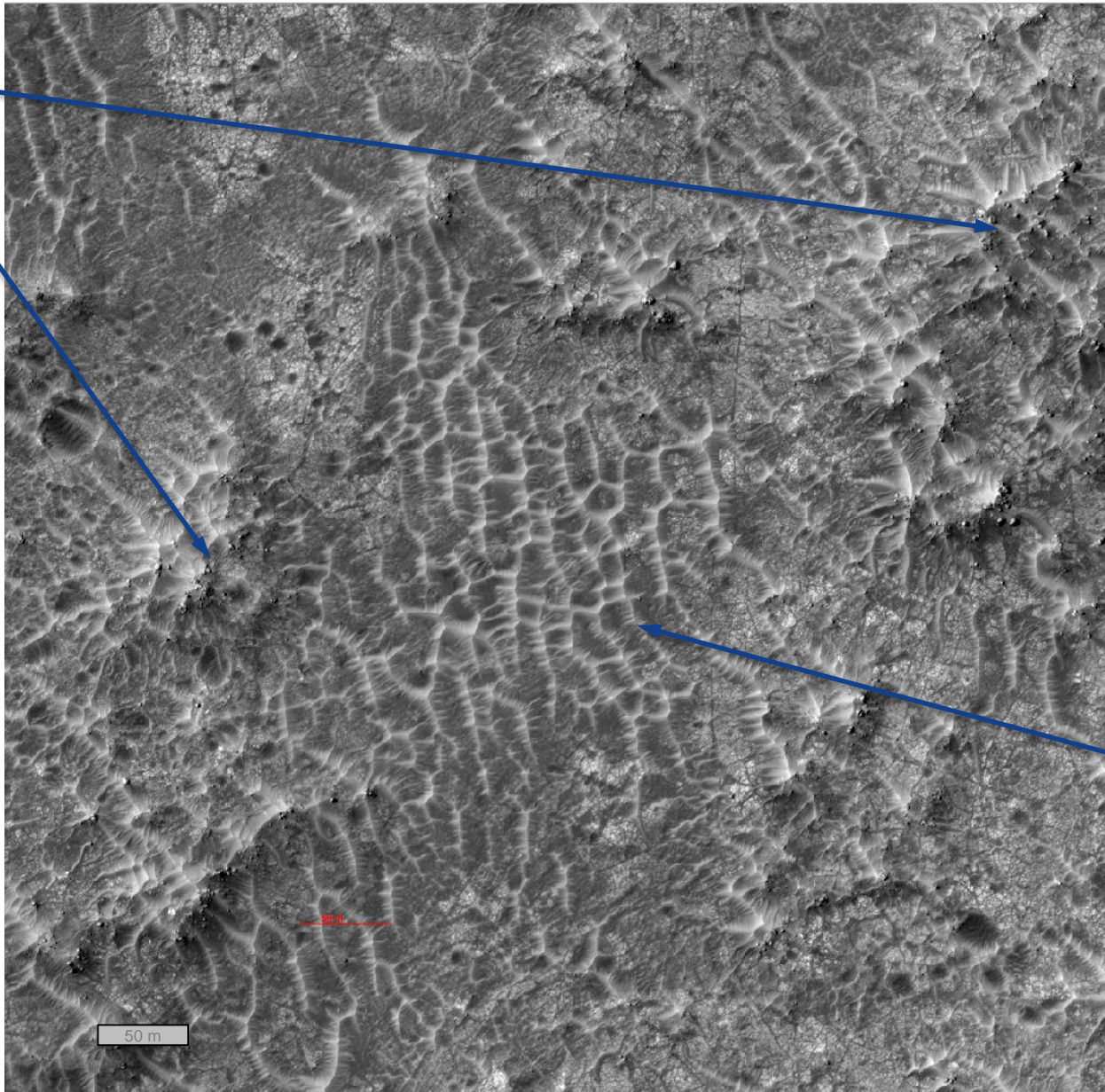
East Margaritifer Terra



Jet Propulsion Laboratory
California Institute of Technology

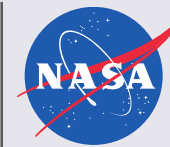
Mars 2020 Project

Rock Fields



Traversable
polygonal ripples

East Margaritifer Terra



Jet Propulsion Laboratory
California Institute of Technology

Mars 2020 Project

Occasional non-traversable sand

